NEWSLETTER

JANUARY 1990

Spala

Ildsot

Kherakhon

Paerebrann

Bacterievuur

Feu bacterien

Ates yanikligi

Zaraza ogniowa

Vaktiriako kapsimo

Fuego bacteriano

Lafha nareya

Feuerbrand

Paronpest

INTERNATIONAL WORKING GROUP

ON FIRE BLIGHT RESEARCH

INTERNATIONAL WORKING GROUP

ON

FIRE BLIGHT RESEARCH

NEWSLETTER

from the

Plant Protection Commission
International Society for Horticultural Science

in cooperation with

U.S. Deciduous Tree Fruit Disease Workers

and

European & Mediterranean Plant Protection Organization

JANUARY 1990

United States Department of Agriculture
Agricultural Research Service

Appalachian Fruit Research Station
Kearneysville, West Virginia, USA

Letter from the Editor

In mid-July 1989, I received a phone call from Dr. Richard Grimm that fire blight had finally been observed inside Switzerland on two Cotoneaster shrubs in a private garden in the beautiful town of Stein-am-Rhein. This town is located north of the Rhine river in the small "peninsula" that juts out into the southern part of West Germany. In addition, in August and October, the disease was observed in the neighboring Cantons of Zurich and Thurgau. As has been the case in many countries before, fire blight is often observed on ornamental host plants before it appears on the pome fruits. Especially Cotoneaster dammeri and C. salicifolius have again proven to be the most susceptible hosts and thus also appear to be the best "indicator" plants to search for the disease in countries still free of fire blight.

Fire blight ("Ates yanikligi") has been officially reported from western Turkey in the region between Afyon (central Anatolian region) and Antalya (south coast). Reportedly, the disease was first detected in 1985 (like Israel and Greece), and in 1987 appeared extremely severe on pear and quince.

For all those who did not attend the Seventh International Conference on Plant Pathogenic Bacteria (Budapest, Hungary) or the Fifth International Workshop on Fire Blight (Diepenbeek, Belgium), the abstracts are reproduced in this newsletter. The complete literature citations will be listed following publication of the proceedings in Acta Horticulturae.

Needless to say, the Belgium workshop was a great success under the able leadership of Tom Deckers and his colleagues at the Research Station of Gorsem. Following three (1990-1992) successful research seasons, we will be looking forward to our sixth workshop in sunny Greece.

TOM VAN DER ZWET, Secretary
North American Section
International Working Group
on Fire Blight Research

COUNTRIES WITH FIRE BLIGHT

Year	Number	Countries
> 1950	4	USA, Canada, Mexico, New Zealand,
1957	5	England
1962	6	Egypt
1966-81	13	Netherlands, Denmark, Belgium, France, Poland, Germany (BRD & DDR)
1982	14	Luxemburg
1984	15	Cyprus
1985	17	Israel, Turkey
1986	21	Sweden, Norway, Ireland, Greece
1987	22	Czechoslovakia
1988	23	Lebanon
1989	24	Switzerland

PRESENT STATUS AND NEW OCCURRENCES OF FIRE BLIGHT

NETHERLANDS

During the period 1982-86, eight pear varieties are being evaluated at the experimental field in Ouwerkerk for their degree of resistance to fire blight. Also being tested are two selections from the Plant Breeding Institute (IVT). By end 1988, selection 69013-18 (Comice x Prec. de Trev.) and 69025-56 (Hardy x Comice) have remained free of blight. Finally, Conference and Comice propagated on Old Home x Farmingdale rootstocks Nr.51 and 333 have not been found any less susceptible than when propagated on quince C.

Theo van der Scheer
Wilhelminadorp

Since 1984, fire blight incidence in the Netherlands is decreasing every year, thanks to the unfavourable weather conditions and the stringent control measures applied.

In 1988 and 1989, fire blight was present in the country, but on a very low level. In pear orchards, there was some infection, but it caused no serious problems to the fruit growers. By pruning out the infected branches, they kept the disease under control. Outside the orchards, fire blight infections were rare.

Rien van Teylingen
Wageningen

WEST GERMANY

In the northern part of Germany, there was only a low incidence of the disease because of dry weather conditions. Only some ornamentals of the genus Cotoneaster showed weak symptoms.

In the middle and south (Rheinland-Pfalz), a limited attack occurred in June/July on apple, hawthorn, and the highly susceptible Cotoneasters because of favourable conditions after hailstorms at this time. In the other southern part of the country (Baden-Wurtemberg), especially in July/August, a higher incidence of the disease was observed, mainly in the area of Stuttgart and Karlsruhe. Besides the ornamentals Cotoneaster salicifolius, C. watereri, and Sorbus aria in the public green, some apples and pears were attacked in the landscape and in allotment garden. Weather conditions were altogether too dry in 1989.

Wolfgang Zeller
Dossenheim

ENGLAND

I am now well ahead with preparing a series of papers on Billing's revised system for fire blight risk assessment.

Eve Billing

Western England - No perry pear blossom infection as this was early due to the mild winter and warm temperatures did not occur until later. 1988 infections progressed when weather warmed up and 100 trees of Green Horse, Gin, and Newbride had to be grubbed on one farm.

Cider apples also flowered early and some were in bloom in the wet and warmer weather, May 22nd and 24th, and blossom infection was severe on some varieties such as Tremlett's Bitter, Breakwell's Seedling, and Vilbevie. This was the worst year for infection since 1978. Secondary shoot infections occurred later, but no cider apples were grubbed.

Eastern England - Blossom on pear and apple overlapped with hawthorn, but although the weather was warm towards the end of apple blossom, infections were few. Favourable weather in late June and July led to disease progression in hawthorn and some infection on pear.

Connie Garrett
East Malling

BELGIUM

First large scale primary blossom infections on apple varieties; Jonagold showed high susceptibility; most susceptible were the pollination varieties James, Grieve, and Idared.

Tom Deckers
St. Truiden

POLAND

In areas of earlier occurrence of fire blight, the disease was not active on apple and pear in 1989. Sporadic infections of blossoms and shoots of hawthorns were observed. Numerous attempts in spring 1989, to isolate the pathogen from 1988 infections were unsuccessful, which indicate that E. amylovora did not overwinter well, supposedly because of very dry winter.

Piotr Sobiczewski
Skierniewice

GREECE

During 1989, fire blight was found in some new areas of Greece; Districts of Kozani, Seres Ilia and Florina, the Islands of Zakynthos, Milos, and Ios.

The disease caused serious problems on pear orchards of the susceptible varieties Kontoula, Passa Crassana, and Santa Maria. In some areas extremely heavy damages occurred especially on the "Kontoula" variety which is very susceptible. In the area of Korinth, 50 more stremas (4 Hectars) were uprooted because of severe damage.

The disease did not cause serious problems on apples. It was not found on ornamentals (Pyracantha and Cotoneaster). It was found on wild pears (Pyrus amygdaliformis) mainly as blossom infection.

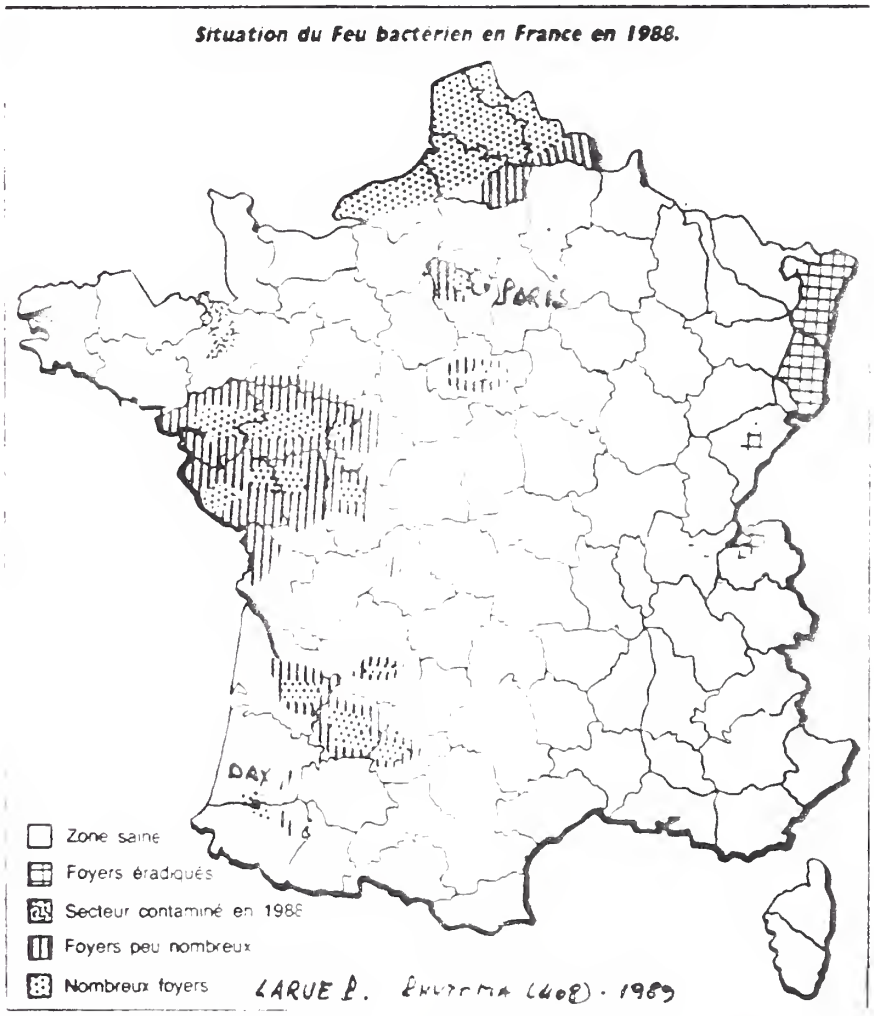
Severe damage as shoot and fruit infection was observed in Northern Greece, following a hailstorm.

Peter Psallidas
Athens

FRANCE

The following map(*) (Larue, 1989) shows the extension of the disease at the end of 1988. During the year 1989, the most striking point has been the activity of the disease in Normandy, on cider apples in young intensive orchards, recently planted with apple varieties selected for quality of crop and juice. Further informations are needed to get precise information on susceptibility of cider apple varieties, but it is likely that some of them are far more susceptible than the susceptible dessert apple (Idared, Reine des Reinettes).

No fire blight has been seen in Alsace (near Germany, along the Rhone Valley) for the third consecutive year. Has the disease been eradicated after destruction of blighted Cotoneaster and Crataegus? It seems unlikely, but possible (?).



(*)Legend: Zone saine: area where fire blight has never been found.
Foyer eradique: no symptoms seen 1987, 1988, 1989.
Secteur contamine 1988: symptoms first seen in 1988.
Foyers peu nombreux: few foci.
Nombreux foyers: many foci.

Jean Pierre Paulin
Angers

EAST GERMANY

Because of the weather conditions in 1989, we had no severe outbreaks of fire blight on pome fruits and ornamental shrubs (frost during the blossom period on pear; particularly dry conditions during summer).

Helmut Kleinhempel
Aschersleben

CYPRUS

During 1989, fire blight presents very low expansion. Although it is present in all pear and apple growing areas of Nicosia, Limassol, and Paphos districts, because of the low temperatures during blooming of pears in 1989 and the encouraging results of the trials carried out for the control of fire blight, as well as the experience achieved since the appearance of the disease in Cyprus in 1984-85, decrease of damages is observed.

There is a growing of interest for the application of control measures and for the monitoring of the weather conditons for better timing of chemical applications. Under the provisions of the project for replacement of susceptible pear and apple cultivars to fire blight, about 6,350 trees were uprooted and $26,900 was paid as subsidies for the uprooting. In addition, $13,700 was paid as subsidies for the re-planting of the uprooted trees in the previous years orchards.

Maria Dimova-Aziz
Nicosia

IRELAND

During 1989, fire blight was found at 4 sites in the Dublin area. The host plants were Pyracantha spp. (3 sites) and Pyrus. The disease was also found at one site in Co. Wicklow on a plant of Cotoneaster salicifolius.

Patrick Walsh
Dublin

CZECHOSLOVAKIA

In 1989, the disease was apparently observed on hawthorn, pear, and apple at 49 sites in the central, northwest, and east Bohemia, lesser so than during 1988.

It was interesting that for the first time fire blight was found in intensive pear orchard at one site. In comparison with 1988, the pathogen spread about 40 km eastward and reached the boundary of Moravia.

All known diseased host plants were eradicated.

Vaclav Kudela
Prague

DENMARK

No change in the fire blight situation in Denmark.

Geltzer Dinesen
Lyngby

ISRAEL

In 1989, fire blight incidence was very low. A few trees infected at bloom stage were reported from three sites. The three pear orchards had been infected in previous years, and in 1989 were treated with streptomycin. Most of the pear and quince orchards all over the country were treated with 2-4 streptomycin sprays during the bloom stage. Fire-stop (flumequine) was tested in one pear and two apple orchards. The spring of 1989 was unfavorable to fire blight with only one rainy day (27-28 March) after pear bud burst. Fire blight was not reported from apple orchards.

Ezra Shabi
Bet Dagan

SWEDEN

The summer (1989) has been very favourable to fire blight. There have been 19 registrated outbreaks, 12 in trees of pear and 8 in bushes of Crataegus. Although none of the outbreaks is more than five kilometers from the coast, fire blight now seems to be well established in the very south of Sweden (the region of Skane).

The work with the disease has gone into a new phase. We no longer believe in the possibility to eradicate fire blight from Sweden. The control measures are now concentrated to reduce the source of inoculum by pruning and eradicating infected hosts, and to recommend to the growers to eradicate all susceptible wild host plants in the surroundings of pear orchards and nurseries.

Magnus Karltorp
Jonkoping

NORWAY

Fire blight is still confined to the same district on the west coast reported earlier. The damage on different species of Cotoneaster was serious in 1989, as was also an attack on Sorbus aria. The eradication program started in 1986 is continued, and is now, as much as possible, concentrated on the removal of the broad-leaved cotoneasters from the district.

Arild Sletten
As

LEBANON

Last month I have returned from Jordan to the Faculty of Agricultural and Food Sciences at the American University of Beirut, Lebanon. The security situation in Lebanon during the spring and summer of 1989 was very bad and unpredictable to allow any survey studies on fire blight as I had planned to do. A student of mine informed me recently that he has seen the disease last summer on pears in an orchard near the town of Laklouk, located on the mountains in the central part of Lebanon. I cannot confirm this before we get a specimen to isolate the bacterium. I hope conditions in 1990 would allow me to make a few trips to study the incidence and distribution of the disease in Lebanon.

Adib Saad
Beirut

TURKEY

Fire blight was firstly detected in 1985 on pear trees grown in Sultandag of the Afyon province of the West Central Anatolian Region. Isolation methods, pathogenicity tests, and other characteristics were searched and antiserum was prepared against it. In 1987, the disease was also detected in Isparta and Burdur though in a limited area. It was observed that apple, pear, and quince trees were attacked, but the harm on pear and quince trees were found to be extremely severe. Consequently, the necessary quarantine measures are applied and an eradication program has been initiated. Application of copper compounds are being used as a means of chemcial control. The Turkish name for fire blight is "Ates yanikligi."

Yavuz Oktem
Ankara

SWITZERLAND

Fire blight was found and isolated for the first time in late summer 1989, in Northern Switzerland. All the focuses were only on Cotoneaster (C. dammeri, C. salicifolius, and not in apple, pears, and quince. The involved plants were removed.

After finding these first infections inside the country, the control of the concerned plants was strengthened. But, there is no change in the fire blight strategy in Switzerland:

- Prohibition of imports of all fire blight hostplants (except for new varieties with a two years stay in a quarantine chamber).
- Severe control on fire blight symptoms in nurseries and orchards.
- Diagnosis and prediction service.

Richard Grimm
Wadenswil

UTAH

Fire blight was insignificant in Utah in 1989, except in the orchards where I inoculated. Environmental conditions were generally too cool during the primary pear and apple bloom periods. We did have some blight in apple in a small geographical area that resulted in substantial shoot blighting as the year progressed.

Sherm Thompson
Logan

INDIANA

Fire blight was very serious in a number of orchards in southern Indiana. The two cultivars most severely injured were 'Ida Red' and 'Gala'. Growers continue to plant more 'Gala'. This marks the fourth consecutive year of severe blight in southern Indiana. The increased frequency of blight is thought to be due to consecutive years of early, warm spring weather and a carryover of high inoculum levels starting with the 1986 fire blight epidemic.

Paul Pecknold
West Lafayette

SOUTH CAROLINA

Increase in plantings of Granny Smith, Gala, and other varieties which are more susceptible than Red Delicious. We are observing shoot blight all the way to the scaffolds or base of tree. These are being colonized by Botryosphaeria spp. The loss of EBDC's and the above portends black and white fruit rot problems.

Walker Miller
Clemson

OREGON

Medford District: Fire blight was mild in pear orchards in 1989 where streptomycin-terramycin treatments were applied. However, those orchardists that did not apply antibiotics were severely affected, with some orchards losing 60-75% of the bearing surface in removal of blighted limbs. Only the Bosc cultivars was severely affected. Infection was associated with very warm temperatures during late bloom.

Willamette Valley: Fire blight was generally not a problem in this area of Oregon due to cool temperatures during bloom. However, each year, including 1989, the Plant Clinic receives one or two specimens of fire blight from this area.

Hood River: Dr. Bob Spotts reports that only a small amount of fire blight was reported from the Hood River Area with the exception of White Salmon, WA. Fire blight was quite severe in that area due to streptomycin resistance. No resistant isolates were detected in the Hood River area. Plan to evaluate forecasting methods during the 1990 growing season.

Milton Freewater Area: Tom Darnell, Umatilla County Extension agent, reported that it was a severe fire blight year in his area. The apple cultivars hardest hit were Gala, Fuji, and Early Gold. Bartlett pears were also hit hard with fire blight. Dr. Ken Johnson did not find streptomycin resistance among any of these isolates this year.

Jay Pscheidt
Corvallis

ONTARIO

Fire blight activity in southern Ontario continued its normal pattern - moderate to severe in areas bordering on Lake Erie in the southwest and western Lake Ontario in the central district, and light to none in the other pome fruit-growing regions of the province.

In the southwest (Essex Co.) there was a high fire blight threat during bloom with the occurrence of warm, wet weather. Severe blight occurred at two sites with high counts of both blossom and shoot blight. Other orchards experienced light infections and none was reported from the fruit-growing regions of a neighboring county (Kent).

Around the western end of Lake Ontario, fire blight was a major concern for growers. In the neighboring Niagara region, pear growers faced a severe situation as control treatments - streptomycin, pruning, sanitation, etc. - did little to stop the spread of fire blight during the summer months.

Gordon Bonn
Harrow

NOVA SCOTIA

Twig blight phase of fire blight reported again from 2 apple orchards near Middleton, N.S. Hawthorn, which were always considered the source of inoculum, showed very few symptoms of fire blight. Twig blight was also reported on pear in Windsor, N.S. While the number of reports of fire/blight and the areas affected by the disease have decreased over the years, the disease remains active in two widely spaced foci in the province.

Gordon Braun
Kentville

BRITISH COLUMBIA

Fire blight was a minor problem in 1989. It occurred in a few orchards which had a history of fire blight infections. Generally it was absent from the major pear and apple growing areas of the interior of British Columbia.

Peter Sholberg
Summerland

SASKATCHEWAN

Very few new fire blight infections were noticed during the 1989 growing season. These occurred on young apple and pear trees and were easily controlled by pruning.

Rick Sawatzky
Saskatoon

NEW ZEALAND

Fire blight was not a problem in most areas of New Zealand this season. The disease was not seen in the low and medium risk areas and was controlled satisfactorily in the high risk areas.

Chris Hale
Auckland

ITALY

Although fire blight besieges Italy, no cases of the disease have been found yet; also extensive phytosanitary inspections in Northern Italy (Veneto and Friuli-Venezia Giulia Regions) near the Jugoslav frontier, carried out in September 1989, had negative results.

Carlo Bazzi
Bologna

SOUTH AFRICA

Not present in South Africa.

Martin Hattingh
Stellenbosch

AUSTRIA

Fire blight has not been recorded in Austria.

Marianne Keck
Vienna

PEOPLES REPUBLIC OF CHINA

There is no confirmed record of fire blight in China. We still pay lots of attention to this disease because it's so important from a quarantine point of view to China. I went to UK in 1986 and met Dr. Garrett, Lelliott, Billing, and Ebbels when I paid visits to East Malling, Harpenden, etc. One of my assistants worked one year at Rugers University on the production of MCA for fire blight. Here in China, we tested many imported Rosaceous seedlings and cuttings every year with different methods. We also paid attention to phage technique and isoelectric focusing for fire blight. Besides, we planned to produce MCA of fire blight in China and attend the Belgium meeting this year. By those efforts we hope we can keep this disease out of China as long as possible.

Zhi-Yong Zhang
Beijing

AUSTRALIA

No fire blight has been recorded within Australia to date. Stringent plant quarantine restrictions apply to imports of fire blight hosts. A fire blight scare was in force in November 1989, on one property in the state of Victoria. Dr. Satish Wimalajeewa was involved in identification of the disease affecting developing Nashi pear fruits. Fortunately it proved to be Pseudomonas syringae.

Fire blight tests negative. No fire blight bacteria has been found on plant material taken from a nashi orchard in northeast Victoria two weeks ago.

Federal Minister for Resources, Senator Peter Cook, and the Victorian Minister for Agriculture and Rural Affairs, Mr. Barry Rowe, announced today that the quarantine order on the property had now been lifted.

The orchard at Moyhu, south of Wangaratta was quarantined on November 9, when officers from the Victorian Department of Agriculture and Rural Affairs found that nashi trees had symptoms resembling the disease fire blight.

Fire blight is a serious disease which infects pome fruit including apples, pears, and nashis. While the disease occurs widely in Europe, North America, and England, it is not present in Australia.

The disease symptoms on the nashi trees on the Mohyu property are now thought to be another bacterial disease caused by an unrelated bacterium, Pseudomonas syringae. It was necessary to import anti sera to the fire blight bacterium from the United States to make the diagnosis.

Senator Cook and Mr. Rowe said that the incident had provided the quarantine service with valuable experience in evaluating procedures for coping with an exotic plant disease outbreak.

They also praised the cooperation of the grower concerned who had given quarantine every assistance in implementing procedures to contain possible disease spread.

David Cartwright
Adelaide

DETAILS ON CURRENT FIRE BLIGHT RESEARCH REPORTED FROM UNIVERSITIES AND EXPERIMENT STATIONS

AUSTRIA

In collaboration with Dr. J. P. Paulin, INRA Research Station, Angers, France: "Utilization of different temperatures for the control of Erwinia amylovora in budwood.

M. Keck
Bundesanstalt fur Pflanzenschutz

ITALY

The project for the development of pear hybrids and varieties resistant to fire blight is still under way at the Istituto Sperimentale per la Frutticoltura in Rome (EEC Fire Blight Working Group).

Phytosanitary checks and analyses on imported plant material are routinely done following the criteria laid down by the Italian Phytosanitary legislation (Ministerial Decree, June 23, 1989, n. 56).

C. Bazzi
Instit. Pathol. Vegetale

NEW ZEALAND

Samples of apples from orchards in low fire blight risk areas of New Zealand with no visible symptoms of the disease have been checked for Erwinia amylovora using the DNA Probe Technique developed by Chris Hale and Rosemary Clark.

We are now satisfied that a combination of orchard inspections and testing of fruit samples (100 fruit/10,000 trees) from each orchard block, together with the removal of alternative hosts from around orchards will guarantee clean export fruit.

C. Hale
DSIR Plant Prot.

OREGON

At the Southern Oregon Experiment Station, replicated field trials of Pseudomonas fluorescens A506 and experimental product X2-1A did not show significant control of fire blight, as compared to untreated controls. Evaluation of several isolates of E. amylovora from pear orchards in the Medford district showed no resistance to Streptomycin at this time. Evaluation of sterilants for cutting tools showed sodium hypochlorite (chlorox) and lysol to be the most effective sterilants tested. Chlorox and lysol diluted 1:5 in water were slightly less effective; denatured alcohol (shellac thinner) was only moderately effective; paint thinner, isopropyl alcohol, and quaternary ammonia were ineffective.

J. W. Pscheidt
Oregon State Univ.

UTAH

The most surprising research result was the reduction of fire blight with Aliette. A single application just 24 hours prior to inoculation reduced the number of infections by over 60%, which was about the same as streptomycin. Tecloftalam was ineffective.

S.V. Thomson
Utah State Univ.

CYPRUS

With the application of the 16.7 - 14.4 C mean temperature predicting line (S.V. Thomson et al., 1982), reduction of the number of applications to 3-4 instead of 6-8 (if applied on routine base) was achieved during the 1989 pear blossom period.

M. Dimova-Aziz
Dept. of Agric.

GREECE

The current fire blight research projects in Greece are:

1) Screening different epiphytic bacteria for in vitro and in vivo inhibition of Erwinia amylovora in order to find possible candidates for effective biological control (Benaki Phytopath. Inst.).
2) Breeding for fire blight resistance among greek varieties and selections (Inst. of Deciduous fruit trees of Naoussa).
3) Chemical control of Erwinia amylovora (Plant Protection Institut of Volos).
4) Climate and fire blight epidemics. (Benaki Phytopath. Inst.).

P.G. Psallidas
Benaki-Phytopath. Inst.

WEST GERMANY

In Dossenheim (Zeller), resistance studies on a new sortiment of apple and pears were carried on. Two Cotoneaster varieties resistant to fireblight were released to trade: C. dammeri 'Holstein Resi', C. dammeri 'Thiensen'. Moreover, control experiments with new bactericide and plant extracts were carried out with up to 70% control of some extracts. A comparison of different cultural practices on the population dynamics of E. amylovora and saprophytic bacteria on the phyllosphere was started.

In Heidelberg (Geider), apathogenic mutants were further characterized for their deficiency in EPS-synthesis.

W. Zeller
Biol. Bundesanstalt

POLAND

Prediction of fire blight. The disease risk assessments, using the revised system of Billing, were made in 2 regions for 2 years. In 1988, relatively high degee of reliability of the system was found. In 1989, fire blight generally occurred at a very low level. Disease risk according to the system in May, was in agreement with its occurrence in nature, but at the end of this month and during June, some infections were not observed at all during the vegetation period.

Efficacy of chemicals against fire blight. Representatives of various chemical groups of fungicides: Aliette, Captan, Dithane M45, Euparen, Fademorf, Mancozeb, Punch 40EC, Ridomil MZ, Rubigan 12EC, Saprol, Sumilex, Syllit, and Topsin M did not show any activity against the disease when tested on pear fruitlets. Ridomil Plus gave similar protection activity as copper preparations.

Antagonistic bacteria against Erwinia amylovora. Bacillus subtilis strain 28HTS, isolated from leaves of Crataegus oxycantha, grown in liquid minimal medium for the genus Bacillus, produced an extracellular substance that inhibited in vitro E. amylovora to a similar degree as living cells. Two active fractions were obtained from the supernatant of 28HTS culture: one soluble in n-butanol, methanol, and ethanol, and the second soluble in water and 0.1% NaOH. However, those fractions tested on pear fruitlets cv. 'Conference' were weakly active against infection by the pathogen and development of fire blight.

P. Sobiczewski
Res. Inst. of Pomol.

EAST GERMANY

Current research projects at the Institute of Phytopathology in Aschersleben are:

- Further investigations on methods of warning and forecasting.
- Evaluation of pear, apple, and ornamental varieties for resistance to fire blight.
- Continuation of control trials in pear, apple, and ornamental shrubs.

H. Kleinhempel
Inst. fur Phytopath.

NETHERLANDS

In close cooperation with the Dutch Plant Protection Service, Henk. J. Schouten (Agric. Univ. Wag.) is working on the spread of fire blight between wild hawthorn and pear. The influence of blooming of wild hawthorn on the occurrence of fire blight gets special attention. The outcome of this field research will be published in the summer of 1990.

In the experimental field, some Cotoneaster x watereri varieties were infected under natural infection pressure. This also happened with the Pyracantha varieties 'Peile d' Olivet' and 'Runyani'. In greenhouse inoculations also, Cotoneaster horizontalis seedlings showed symptoms. Cotoneaster amoenus proved to be the most resistant species in the greenhouse test. Crataegus laurentiana var. brunetiana looked very promising in the greenhouse test. In the field also, C. arnoldiana showed fire blight symptoms in 1989.

Cotoneaster. In the experimental field for fire blight, situated in the southwest part of the Netherlands, the following Cotoneaster x watereri varieties showed natural infection: 'Gerrie', 'Jose', 'Pride of Leersum' and 'Willeke'. C. x watereri 'Corina', however, was not attached.

Crataegus. Within the scope of the breeding research for resistance against fire blight, glasshouse inoculations were carried out with Crataegus. Of 430 provenances from botanic gardens, totally 1000 seedlings were tested. Particularly provenances of C. arnoldiana, C. flabellata, and C. succulenta seemed to be less susceptible. All the tested provenances of C. monogyna proved to be very susceptible.

Pyracantha. In 1988, 480 clones from the breeding program with Pyracantha were tested through inoculation in a glasshouse for their susceptibility to Erwinia amylovora. In the seedling stage, these plants could stand the test. In the clonal stage, however, many clones proved to be highly susceptible to fire blight. Clones from the crosses with 'Dart's Red' or 'Shawnee' again showed a high level of resistance against Erwinia amylovora.

Sophieke Bouma
Boskoop

FUTURE MEETINGS

1990

August 4-9	American Phytopathological Society Grand Rapids, Michigan
September	U.K. Fire Blight Workshop University of Bath
Oct. 28-Nov. 3	8th Congress Mediterranean Phytopath. Union Agadir. Morocco
December 4-7	Joint Symposium World Meteorological Organ. European Plant Protection Organization Florence, Italy

1991

August 18-22	American Phytopathological Society St. Louis, Missouri

SIXTH

International Workshop
on Fire Blight

G R E E C E

September 1992

MISCELLANEOUS NEWS

Dr. S. Ochiatt (Argentina) took a post-doc position at INRA-Angers (Plant Breeding Section) for 2 years. He works with E. Chevereau (on pear protoplasts). Part of his programme involves fire blight (co-culture of pear protoplasts and *E. amylovora*) with M.N. Brisset, Plant Pathology Section.

Chris Hale has been appointed Group Leader - Horticulture, in the new DSIR Plant Protection Division, which is an amalgamation of the former plant diseases and entomology divisions of DSIR.

P.G. Psallidas attended the 7th International Conference on Plant Pathogenic Bacteria, (Budapest, 11-16 June, 1989).

P.G. Psallidas and J. Tsiantos attended the 5th workshop on fire blight June 19-22, 1989, Belgium and an Agrimed EEC Meeting on fire blight research at Gorsem Research Station following the workshop.

Breeding research on fire blight resistance in woody ornamentals in The Netherlands will be terminated within a few years. This is caused, e.g., by Dr. A. Sophieke Bouma leaving the job in the course of 1990.

From October 1989, Amanda Waddingham began her MAFF studentship on "Virulence and resistance in fire blight", at the University of Bath (visit with Dr. R. Cooper).

Dominice Howditt has started a Ph.D. project on "Biological Control of Fire Blight" at the University of Manchester (with Drs. H. Epton and D. Sigee).

Drs. Connie Garrett and David Stead visited the People's Republic of China in May 1989, under the UK/China Memorandum of Understanding to lecture about fire blight and, also, rapid methods of identification of plant pathogenic bacteria and bacteria of quarantine significance.

The UK had 6 delegates at the 5th Fire Blight Workshop in Belgium in June, to which they contributed 4 papers and 6 posters.

The EEC "book" on fire blight: "Fire blight of *Pomoideae* (*Erwinia amylovora* Burrill, Winslow et al.) applied research in Europe (1978-1988)" will be published in 1990. It is mainly based on results obtained in Europe during two successive programmes subsidized by EEC. The sections of this book are:

- Climatic studies (E. Billing, J.P. Paulin, C. Jacquart-Romon)
- Control (C.M.E. Garrett, M.M. Lopez et al., M.N. Brisset)
- Selecting and breeding for resistance

. Pome Fruit

1) Assessment of susceptibility (B. Thibault, M. LeLezec, W. Zeller, J. Huet, J.C. Michelisi, J.P. Paulin, R. Chartier, J.M. Bore).

2) Breeding for resistance in pear and apple (B. Thibault, Y. Lespinasse, R. Quarta).

. Ornamental Pomoideae

1) Assessment of susceptibility (A.S. Bouma, A. Cadic, P. Lecomte).

2) Breeding for resistance (F. Persiel, W. Zeller, A.S. Bouma, A. Cadic, J. Belin).

- Annexes (among which: Fire Blight: An illustrated field guide. E. Billing)
- A list of references (G. Lachaud)

It is a nearly 300 pages book, in English, French, or German, according to contributors.

It will be available during 1990 (on sale from EEC, 200, rue de la Loi, Brussels). Price not known at the moment.

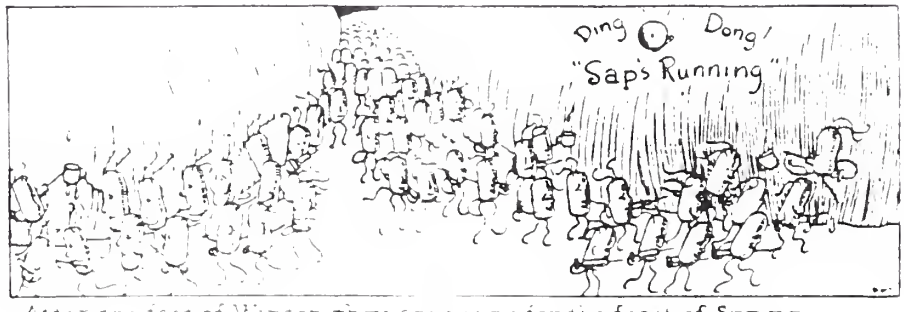
Dr. Ken Johnson has recently been hired in the Botany and Plant Pathology Department of Oregon State University as the new Tree Fruit and Nut Pathologist. Dr. Johnson is planning to initiate a few biological control projects on Fire Blight in cooperation with Dr. Joyce Loper of the USA. Virginia Stockwell has also been hired as a Research Associate to work on biological control of Fire Blight with Dr. Loper.

Eight Dutch fire blight workers participated in the Fifth International Workshop on Fire Blight (ISHS) in Hasselt, Belgium in June 1989.

Chris Hale and Chin Gouk attended the 5th International Workshop on Fire Blight. Chris Hale visited the Australian Department of Agriculture to discuss detection techniques for Erwinia amylovora, and orchards in the major pipfruit areas of Australia.

Rosemary Clark demonstrated a DNA probe technique for detection of Erwinia amylovora associated with apple fruit at the 7th Australian Plant Pathology Society Conference in Brisbane, Australia.

Dr. John Yorston died instantly in a traffic accident in Kelowna, B.C., on the evening of January 23, 1990. He was 46 years old, a graduate of the University of British Columbia, and Oregon State University, and had worked for the B.C. Ministry of Agriculture and Fisheries since 1971 as an extension specialist on disease of tree fruit crops.

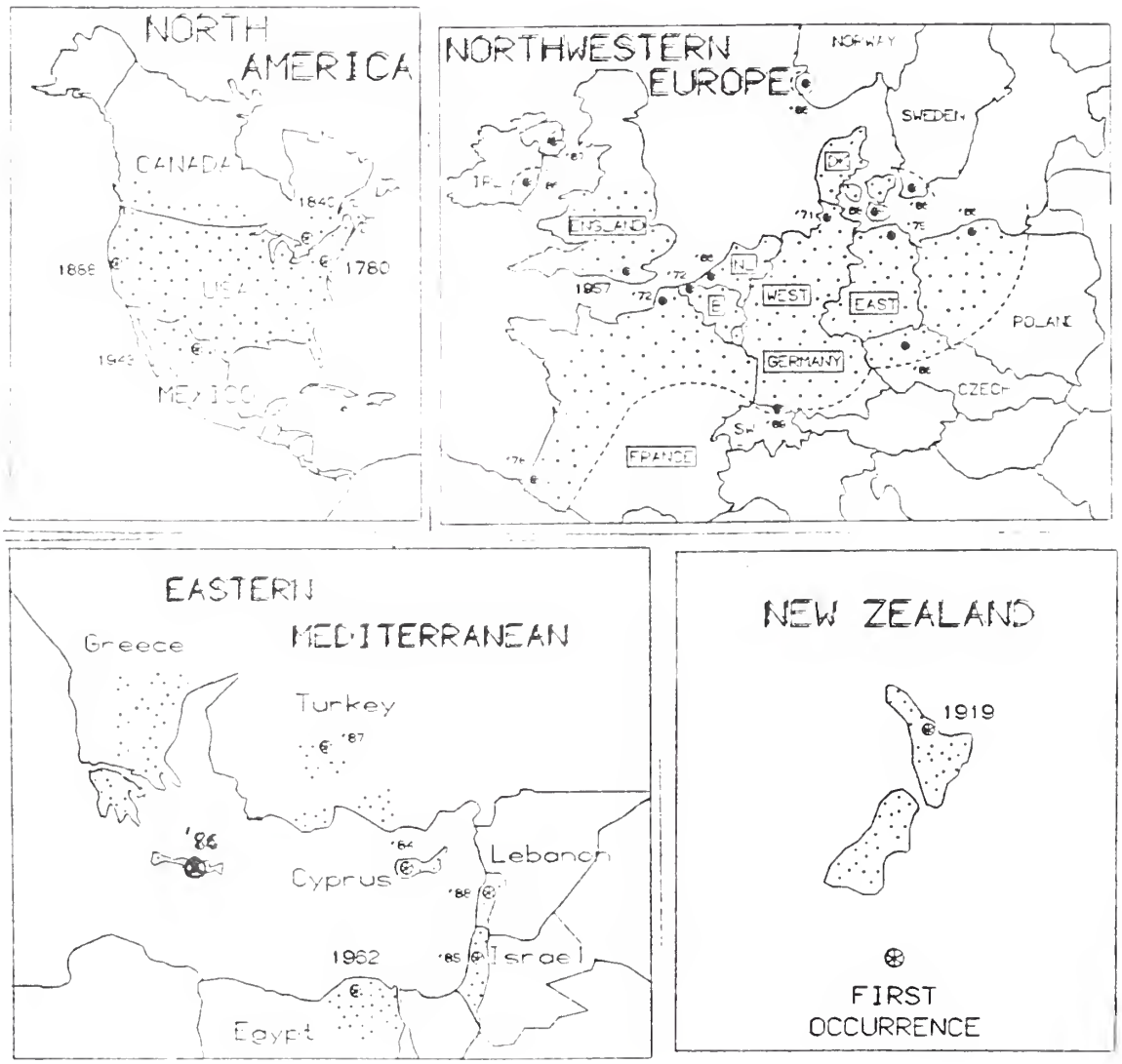


After the feast of Winter they are ready for the feast of Spring

NEW THESES AND DISSERTATIONS

Name	Thesis or Dissertation Title	Univ.	Degree	Year
J. Viseu	Contribution a l' etude de la culture *in vitro* et de ses applications pour l'amelioration genetigue deis plantes. recherche de techniques d' obtention et de selection de variants somaclonaux e di poirier et de pommier resistants au feu bacterim.	Gembloux	PH.D.	1989
Laurence Malandrin	Etude des modifications de la permeabilite cellulaire provo quees chez *Pyrus communis* par *E. amylovora*, agent du feu bacterien.	Angers	M.S.	1989
Lydie Gardan	Etude de l'effet de quelques sucres sur l'expression des symptomes du feu bacerien du poirier (*Erwinia amylovora*).	Rennes	D.E.A.	1989
David Youle	Pathogenicity factors and their induction in *Erwinia amylovora*.	Bath	Ph.D.	1989
Robert Raskall	The cell surface biochemistry of *Erwinia amylovora*.	Thames Polytechnic	Ph.D.	1990
N. Jahn	Characterization of a toxin gene from *Bacillus thuriengensis* subsp. *tenebrionis* and mutation analysis with the phytopathogenic bacterium *Erwinia amylovora*.	Heidelberg	Ph.D.	1989
R. Theiler	Virulence factors of the fire blight pathogen *Erwinia amylovora* in its interaction with pear cells.	Heidelberg	Ph.D.	1989
Henk J. Schouten	Epidemiology of fire blight.	Wageningen	Ph.D.	1990

WORLDWIDE DISTRIBUTION OF FIRE BLIGHT



7th INTERNATIONAL CONFERENCE on PLANT PATHOGENIC BACTERIA
11-16 June. 1989.

ABSTRACTS OF PAPERS AND POSTERS

ON ERWINIA AMYLOVORA

Budapest—Hungary

[illegible]

When cultured [illegible] sucrose *Erwinia amylovora* synthesizes an extracellular polysaccharide composed of fructose. As a result of the sucrose polymerizing activity sucrose appears in the culture fluid. This led us to the assumption that *E. amylovora* harbours a secretory fructosyltransferase similar to the levansucrase (EC 2.4.1.10) of *Pseudomonas syringae* pv. *glycinea* (Gross and Rudolph, J. Phytopathology 119, 289-297, 1987). Pertinent studies revealed that high levels of fructosyltransferase are excreted into culture fluids of *E. amylovora*. The enzyme was purified by ion-exchange column chromatography and preparative isoelectric focussing. The [illegible] characterized by gel electrophoretic techniques and compared with the levansucrase of *P. s. glycinea*. [illegible] *amylovora* [illegible] capsule [illegible] different [illegible] polysaccharide.

EFFECT OF THE EPS OF ERWINIA AMYLOVORA ON THE PHENOL METABOLISM OF CYDONIA VULGARIS

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Federal Biological Research Centre for Agriculture and Forestry, Institute for Plant Protection in Fruit Crops, D-6905 Dossenheim

Studies on the mode of action of the extracellular polysaccharide (EPS) of the fireblight pathogen Erwinia amylovora were undertaken, in order to clarify, if EPS has an essential function during symptom expression or as virulence determinant. As phenol metabolism plays an important role during the resistance reaction in many host parasite interactions the total content of phenols, the qualitative changes of individual phenols and activity of phenoloxidase were estimated after EPS-treatment and infection with 10 cfu/ml of bacteria in leaves of quince (6 - 72 h/pi). From the results it could be shown that the EPS has a light reducing effect on the phenol metabolism in the plant, as for example a slight reduction in the phenoloxidase activity, in the total phenol content and of several phenols (o-cumar acid, catechin, gallus acid) during the entire experimental period, however in the inoculated leaves a drastic effect in regard to a marked reduction of the whole phenol metabolism could be observed. A drastic decrease was detected in the content of o-cumar acid, rutin and catechin, whereas arbutin as a resistance component showed no change in the initial stage of infection. Thus EPS appears to have more a stabilizing effect on host cell structure in regard to an inhibition of the phenol metabolism of the host plant in the initial development of the disease and to counteract an early tissue destruction like a hypersensitive reaction.

ANTAGONISTIC BACTERIA AGAINST *ERWINIA* [illegible] SYRINGAE AND *ERWINIA AMYLOVORA* FROM [illegible] GROWING PLANTS

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(Research Institute of Pomology and Floriculture)
Pomologiczna 18, Skierniewice, Poland

Among 240 bacteria isolated from leaves and flowers of 28 species belonging to 18 genera of wild growing plants, isolates of the antagonistic activity against *Erwinia amylovora* and *Pseudomonas syringae* when tested on potato-dextrose (PDA) medium, medium with mannitol and minimal medium for genus Bacillus. Ten of those isolates inhibited both *E.amylovora* and *P.syringae*, five only *P.syringae* and three only *E.amylovora*.

Eight of all antagonistic isolates were gram-positive spore-forming bacilli, nine were gram-negative fluorescent rods and one was gram-negative not spore-forming and nonfluorescent rod.

The spore-forming isolate marked as 28 HTS gave the largest inhibition zones both to *E.amylovora* and *P.syringae* on all of the media used. When this isolate was grown in liquid minimal medium for genus Bacillus it produced an extracellular substance that inhibited *E.amylovora* to a similar degree as living cells. From the supernatant of the 28 HTS culture two active fractions were obtained: the one dissolvable in n-butanol, methanol and ethanol and the second dissolvable in water and 0.1% NaOH. The fraction dissolvable in water was dialysed and its molecular weight as resulted from gel filtration was about 20[illegible].

DISEASE RISK ASSESSMENT: CHANGES TO BILLING'S SYSTEM FOR FIREBLIGHT

BILLING, E.
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Experience in England, Europe and North America indicates that Billing's original fire blight risk assessment system (Billing, 1982a, Ann. appl. Biol., 95, 341-6., 365-77) could be improved and the approach made more logical. A revised table of PE values is now used (Schouten, 1987, Neth. J. Plant Path., 93, 55-60) and, with this, some modifications are no longer necessary. Infection and insect risk assessment methods are changed and the rain scoring method adjusted slightly to allow for warm climates. The graphical presentation is greatly simplified and easier to understand. Weather analyses can only judge relative risks under a given set of conditions. For the assessment of absolute risks, other factors, including host susceptibility, have to be taken into account but they are not easy to quantify.

FIRE BLIGHT CONTROL WITH KASUMIN ON APPLE AND PEAR

COTTER, C. and KAARE, E.
(Deutsche Hoechst A.G., Department Crop Protection, P.O. Box 7033, 1007 JD Amsterdam, The Netherlands)

December 1982 the basic compound kasugamycin was registered in the Netherlands for the control of bacterial diseases in ornamental nurseries. Because of the close relationship between kasugamycin and copper, both compounds are restricted for use in agriculture. The basic compound is produced by Industry Co. Ltd. Tokyo, Japan.
In 1983 and 1984 efficacy trials were carried out by the Dutch Plant Protection Service.

A One trial was done against blossom infection in Cotoneaster. For artificial infection a suspension of bacteria was used (10⁷ cells/ml). Treatments were carried out 5 hours before infection (preventive) or 18 hours after infection (curative). About 600 flowering clusters per object. Assessments were done 2 weeks later (4 replicates).

Table 1 Efficacy of one kasumin-treatment against fire blight (preventive or curative).

object	dosage	per hl	% infected clusters	% cur
Kasumin 25 W.P. (1)	0.05%	15	4 b	8
Kasumin 25 W.P. (1)	0.12%	30	1 b	5
streptomycin (1)	0.04%	10	4 b	8
copper oxychloride (1)	0.30%	150	5 b	8
Kasumin 25 W.P. (2)	0.04%	10	9 b	-
Kasumin 25 W.P. (2)	0.12%	30	4 b	8
streptomycin (2)	0.04%	10	10 b	4
untreated	-	-	31 a	-

(1) preventative spraying (2) curative spraying (3) hours (3) t-test (P < 0.05)

B Also a trial was done with natural infection in Cotoneaster watera 'Pendula'. During blossom period weekly assessments on infection (4 replicates).

Table 2 Efficacy of kasumin against fire blight (4 treatments during blossom period)

object	dosage	per hl	% infected clusters	%
Kasumin 25 W.P.	0.05%	15	1	5
streptomycin	0.04%	10	0	0
copper oxychloride	0.20%	100	3 b	6
untreated	-	-	51 a	

(1) t-test (P < 0.05)

Conclusion
In the tested dosages kasumin (the basic compound of kasugamycin) is effective against fire blight. Efficacy (preventive, curative or in case of infection) is comparable to streptomycin and copper oxychloride.

MECHANISM BY WHICH THE ANTIBIOTIC OF *ERWINIA HERBICOLA* Eh318 INHIBITS *ERWINIA AMYLOVORA* Ea273

WODZINSKI, R. S., MUDGETT, M. B. and BEER*, S. V.
(Biology Department, Ithaca College, Ithaca, NY 14850; *Department of Plant Pathology, Cornell University, Ithaca, NY 14853 USA)

Antibiotic production is important in the mechanism by which some strains of *E. herbicola* inhibit *E. amylovora*. The antibiotic of Eh318, which inhibits Ea273, is not inhibitory to Ea273 in the presence of a combination of arginine and histidine; arginine has a much greater effect on reducing the toxicity of the antibiotic to Ea273 than does histidine. A crude preparation of the enzyme N-acetylornithine transaminase of Ea273, which converts N-acetylglutamyl semialdehyde to N-acetylornithine in arginine biosynthesis, is inhibited by the purified antibiotic of Eh318. Kinetic analysis with partially purified enzyme shows that the antibiotic of Eh318 is a competitive inhibitor of the enzyme when N-acetylornithine is the varied substrate. The transaminases of Eh318 and Ea273R318, a spontaneous mutant of Ea273 that is resistant to the antibiotic of Eh318, are both inhibited by the purified antibiotic. Thus, resistance to the antibiotic is not the result of altered (resistant) forms of the transaminase.

ELECTRONMICROSCOPICAL [illegible]
PROCESS OF FIRE BLIGHT

EHRIG, F., RICK[illegible] and MATTH[illegible]
(Institute of Phytopathology, Academy of Agricultural Sciences GDR, Theodor-Auerbach-Weg, 4[illegible] Aschersleben GDR)

A characteristic symptom for fire blight is the formation of exudate drops, which have great importance as an inoculum reservoir for the spreading of the disease. At high air-humidity the formation of exudate drops occur, as a rule, on the surface of infected plant parts being visually visible good at a corresponding size.
By means of scanning electron microscopical studies, however, it could be detected that exudate is already present 48 hours and under certain atmospheric conditions exudate does not emerge from the stomata of infected plant parts as drops but forming filaments ("strands"). These "strands" strongly varying in length and diameter are not to be distinguished from other plant structures (f.ex. plant hairs trichomes) without auxiliary means and occasionally even scanning electron microscopically.
Because of the confessed great importance of the "strands" further studies on the conditions of their origin and function

DISPERSAL OF ANTIBIOTIC MARKED ERWINIA AMYLOVORA FROM INOCULATED FLOWERS

THOMSON, SHERWIN V.
(Department of Biology, Utah State University, Logan, Utah 84322-5305, USA

Isolates of Erwinia amylovora resistant to 5 µg/ml of either Rifampicin or Nalidixic acid were selected from King's medium B with the antibiotics incorporated. The marked strains were comparable to wild type E. amylovora in physiological and pathological tests. Flowers of pear or apple were inoculated with 10^4 cells of the marked strains in 10 µl of sterile saline on either the pistils or the hypanthium. Inoculations on the hypanthium resulted in 80% infection whereas only 20% of the pistil inoculations were successful. Infections by marked bacteria were found on non-inoculated trees up to 60 m distant.

DETERMINATION OF EARLIEST BLOSSOM BLIGHT SYMPTOMS ON PEAR AND APPLE FOLLOWING IN SITU INOCULATION WITH VARIOUS INOCULUM LEVELS OF *ERWINIA AMYLOVORA*

VAN DER ZWET, TOM
United States Department of Agriculture, ARS
Appalachian Fruit Research Station
Kearneysville, WV, USA

Individual blossoms of several varieties of pear and apple were inoculated with *Erwinia amylovora* in the field during the bloom seasons of 1987 and 1988. The inoculum (50 ul of phosphate buffer suspension of 10^2, 10^5, or 10^8 CFU/ml) of three isolates (NY 266, NY 173, and Merrow 2002A) was applied with a micro pipet dispenser on several dates. The main object was made to determine the earliest detectable (visible) symptoms of blossom blight. Significantly more pear and apple blossoms blighted following inoculation with 10^8 than with 10^5 or 10^2 CFU/ml, whether isolates were applied individually or as a mixture. Depending upon the date of inoculation and the corresponding temperature during incubation period, appearance of earliest blossom blight symptoms (ooze droplets at base of blossom receptacle) varied from 5 to 13 days on 'Bartlett' pear and 8 to 11 days on 'Jonathan' apple. Blossoms inoculated with buffer solution alone, resulted in 1% ('Jonathan') and 3% ('Bartlett') of blossoms infected, presumably due to the presence of natural epiphytic *E. amylovora* bacteria. Measurable, but no significant differences in control were obtained when inoculated blossom clusters were sprayed with 65% streptomycin within 24-72 hours of inoculation.

CLIMATIC DATA AND FIRE BLIGHT OCCURRENCE IN GREECE

PSALLIDAS P.G.*, KETALIS D.A.** and TSIANTOS J.***
*Benaki Phytopathological Institute, 8 Delta Str., GR 145 61 Kifissia, Athens, Greece
**National Observatory of Athens, Met.Institute, P.O. Box 20048, GR 116 10 Athens, Greece
***Plant Protection Institute, P.O. Box 303, GR 360 01 Volos, Greece

Fire blight was first found in Greece in 1984 in an isolated area and in 1985 in the island of Crete. A serious outbreak of the disease occurred in 1987 when it was found almost in every pome fruit growing area.

In order to explain the behaviour of the disease the climatic parameters used in Billing's system were collected. The potential for fire blight activity during the blossom period for the years 1984-1988 in three different regions in Greece including the region where the disease was for the first time recorded was assessed according to the Billing's system. The obtained theoretical results were compared with the field observations of disease occurrence. Generally it was found that there was a quite good correlation between the predicted disease development and the disease occurrence in nature. The epiphytic occurrence of *Erwinia amylovora* on buds, flowers and leaves and its possible connection with the weather conditions was also investigated, with the method of washing of samples put at different stages. *Erwinia* was not detected as epiphytic in most of the cases.

DEVELOPMENT OF FIRE BLIGHT EPIDEMICS OF PEAR IN NORTHERN OF EGYPT DURING 1984 TO 1988

SEIF El-NASR, H.I.
(Pests and Plant Protection Dept., National Research Center, Dokki, Cairo, Egypt)

The first out break of fire blight had ever known on pear plants "Le Conte" variety in Egypt was recorded in 1982 at Alexandria governorate. During 1984 the epidemics covered the cultivated area of Alexandria to Rashid province then moved south to Behera and western to Kair El-Sheikh governorates. In 1985 epidemics covered about 90% of pear orchards in Behera and in 1986 they were all covered with infection. In addition to the northern parts of Gharbia governorate. During the growing season of 1987 the infection was recorded in Dakahlia with a severity of 40 blossom blight, then it reached 75 to 90 in 1987 and 1988. Incidence of disease in all areas has been recorded between 15 upto 24 of April. Humidity, rainfall and temperature were favorable to disease incidence. Symptomatology, isolation, identification and pathogenicity which has been carried out from 1984 to 1988 confirmed the presence of different *Erwinia amylovora* isolates.

PLASMID DETECTION IN ISOLATES OF ERWINIA AMYLOVORA IN EGYPT.

ABU-EL-DAHAB, M.A., M.A. EL-GOGHARY, W. ZELLER* and A.I.A. SHOEIB.
Department of Plant Pathology, Faculty of Agriculture, Alexandria University, Alexandria, Egypt.
* Biologische Bundesanstalt, Heidlberg, Dossenheim, Fed. Rep. of Germany.

Eighty seven isolates of *Erwinia amylovora* were examined using the rapid procedure of Kado and Liu, for plasmid detection. The size of *E. amylovora* plasmids was determined in comparison with those of a reference isolate of *Xanthomonas stewartii* Sm. which is known to harbour 12 plasmids.

Most of the tested isolates of *Erwinia amylovora* (94.3%) harboured one plasmid with molecular mass of 25 Megadalton. Three isolates carried 2 plasmids with molecular mass of 25 and 43.3 M.dal. However, no plasmids were detected in case of two isolates. No clear correlation could be observed between the detected plasmids and colonial morphology, virulence or streptomycin resistance of the tested isolates of *Erwinia amylovora*. This may still leave open the possibility that these characters are not connected with plasmids or may be correlated with other plasmids not detectable by the method used in the present study.

ROLE OF ANTIBIOTIC PRODUCTION BY *ERWINIA HERBICOLA* Eh252 IN REDUCING THE INCIDENCE OF FIRE BLIGHT

VANNESTE J.L., SMART L.E., ZUMOFF C.H., YU J. and BEER S.V.
(Department of Plant Pathology, Cornell University, Ithaca, N.Y. 14853 USA)

Strain Eh252 of *E. herbicola* is highly effective in reducing fire blight incidence in apple orchards. *In vitro*, it inhibits *E. amylovora* by antibiosis. To examine the role of antibiotic production in the control of fire blight, non-antibiotic-producing mutants of Eh252 were created using a derivative of bacteriophage lambda as a vector for *Tn5*. For two of these mutants, presence of a single *Tn5* insertion has been shown by Southern hybridization using as probe the *Tn5*-containing plasmid pRZ 102. Tests on immature pear fruits revealed that these two mutants were not able to reduce the development of *E. amylovora* as well as the wild-type strain Eh252. These data suggest that antibiotic production is involved in the ability of Eh252 to inhibit *E. amylovora*. Complementation of the mutants is in progress.

DETERMINANT OF PATHOGENICITY TO PEARS AND ABILITY TO CAUSE THE HR IN NON-HOST PLANTS CLONED FROM ERWINIA AMYLOVORA

WALTERS, P., MARCONI, A., HITCHIN, E.R. and MANSFIELD, J.W.
(Department of Biochemistry and Biological Sciences, Wye College, University of London, Ashford, Kent, TN25 5AH, UK)

A genomic library of E. amylovora wild-type isolate OTI was prepared in the cosmic pLAFR3 and mobilised into the capsulated mutant P which, unlike OTI fails to cause fireblight symptoms in pear or the HR in beans or tobacco. Three clones were identified which restored virulence and ability to cause the HR to mutant P. Subcloning and transposon mutagenesis with Tn5lac located the determinant of virulence on a 2.1kb BamHI/HindIII fragment which was common to each clone. This fragment also restored ability to cause the HR.

[illegible] AGE [illegible]
Erwinia amylovora [illegible]

MENDOZA, M.A. and [illegible]
(Centro de [illegible]
tecillos, Méx. and C.P. Pedr[illegible]

(Station de Pathologie végétale [illegible]
France)

A study of streptomycin [illegible]
within nature populations of *Erwinia amylovora* [illegible]
Winslow *et al.* has been undertaken.

Inoculations of slices of immature apple fruits with single bacterial cells from isolates [illegible] sions have revealed an heterogeneity in virulence between colonies of the same origin or even from the same lesion. Conversely, other characteristics of the bacteria examined were stable. This was true for biochemical tests as well as for protein and phage patterns. Such a stability of these characteristics was similarly found in culture from collection, whatever their origins (host-plant or geographical area).

Avirulent variants were mainly found in well-developed or apparent or even dormant lesions but we have not been able to isolate them from young extending lesions or from exudates, where the bacterial populations were actively growing.

It is therefore likely that [illegible] lence of populations of *E. amylovora* could be a factor of importance in the variation [illegible] the disease, very frequently observed but rarely fully explained by climate or different [illegible] tors, plant susceptibility [illegible]

NUMERICAL VARIATION OF FATTY ACID CLASSES OF NUMEROUS STRAINS OF ERWINIA AMYLOVORA.

VAN DER ZWET, T. and WILCOX, W.F.
United States Department of Agriculture, ARS, Appalachian Fruit Research Station, Kearneysville, WV, and Eastern Regional Research Center, Philadelphia, PA, USA.

Gas liquid chromatogram (GLC) analysis of 147 isolates of *Erwinia amylovora* from various Rosaceous host plants, collected from 5 states in the USA and 10 foreign countries, produced a library of 7 fatty acid classes characteristic for this species. When 3 strains were grown for 1, 2, and 6 days on 4 media, glucose-yeast extract-carbonate agar (GYCA), King's medium B (KB), nutrient agar (NA), and trypticase soy agar (TSA) at 27° C, the percentage of saturated, even-carbon straight chains (Class A) were significantly higher on GYCA than on the other media. On NA and TSA, the saturated, odd-carbon straight chains (Class B) were 3-4 times higher than on GYCA and KB. As cells aged, concentration of saturated acids (Class A & B) increased and unsaturated acids (Class C) decreased, resulting in a shift of the ratios from 1.2 to 1.7. When nine streptomycin-resistant (SR), and 9 strep-susceptible (SS) strains of *E. amylovora* were grown on TSA for 3 days, the percentage of cyclic acids (Class F) were consistently lower (3.1% of total fatty acids) for the SR strains than for the SS strains (7.1%). The reverse was observed for unsaturated acids (SR strains with 37.5% and SS strains with 32.9% of total fatty acids). These differences were reflected in the ratio of saturated to unsaturated acids: which for SR strains was 1.2 and for SS strains 1.5. Thus, strep resistance of *E. amylovora* isolates may be predicted by determining such ratios using GLC analysis.

MOLECULAR BIOLOGY OF PATHOGENICITY IN THE GEN ERWINIA: AN OVERVIEW

COLLMER, A
(Department of Plant Pathol[illegible]
Ithaca, NY 14853 USA)

The genus Erwinia encompasses diverse enterobacteria that share an ecological association with plants. The molecular mechanisms underlying the diseases caused by E. amylovora, E. stewartii, and the "soft-rot erwinias," E. carotovora and E. chrysanthemi, are now being investigated with genetic tools developed in the model enterobacterium Escherichia coli. These studies have revealed that the primary disease determinants are as different as the diseases caused by these bacteria. Pectic enzymes play a key role in the tissue maceration caused by soft-rot erwinias, whereas extracellular polysaccharide production is important in Stewart's wilt of maize incited by E. stewartii. Extracellular polysaccharides contribute to the virulence of E. amylovora, but the bacterium produces no pectic enzymes and the nature of the primary disease determinant is unknown. Current research on the molecular biology of pathogenicity in the erwinias is focused on continued identification and evaluation of primary disease determinants, elucidation of the mechanisms by which these factors are regulated and [illegible] of additional factors that contribute to plant-microbe interaction. [illegible] serve to introduce the following sessions by emphasizing factors that are common to erwinia diseases, pathogens but not necessarily shared by well-studied, nonpathogenic enterobacteria such as E. [illegible]

CREATION AND ANALYSIS OF MUTANTS OF *ERWINIA AMYLOVORA* ALTERED IN PATHOGENICITY

BARNY, M. A.[1], PAULIN, J. P.[2], and LAURENT, J.[3]
([1] Laboratoire de Pathologie Végétale, INRA, 30 rue Claude Bernard, F 75231 Paris Cedex 05, France; [2] Station de Pathologie végétale, INRA, Beaucouzé, F 49000 Angers, France.)

The *Erwinia amylovora* strain CFBP1430 is a natural isolate showing stable virulence on different host species susceptible to fire blight. For this reason this strain was used to isolate avirulent mutants. Transposon mutagenesis was realized by using MuPR13 which confers resistance to chloramphenicol and gives stable insertions because transposition functions have been deleted. More than 4000 Cm[r] clones were screened for the loss of the ability to induce exudate production on apple calli (Cal[+] clones). The 46 prototrophic Cal[-] mutants with a single insertion were tested for symptom production on apple and pear seedlings and on axenicly grown [illegible] pear seedlings. 22 Cal[-] clones produced symptoms on any type of host material. On apple and pear seedlings, [illegible] CFBP1430 and 17 others showed reduced virulence on axenicly grown pear seedlings; they all presented diverse degrees of [illegible]. 21 Cal[-] clones were totally avirulent; they produced no symptom neither on apple and pear seedlings nor on [illegible]. The 21 avirulent mutants were tested for their ability to induce hypersensitive response on tobacco leaf slices; 5 were unable to induce HR and 16 were not. These results indicate that in the assay on apple calli [illegible] pathogenicity genes [illegible] *E. amylovora*. The avirulent [illegible] that [illegible]. Most of these appear to be [illegible] genomic region.

ELICITATION OF THE HYPERSENSITIVE RESPONSE BY *ESCHERICHIA COLI* CONTAINING A CLUSTER OF PATHOGENICITY GENES FROM *ERWINIA AMYLOVORA*

BEER, S. V., ZUMOFF, C. H., BAUER, D. W., SNEATH, B. J. and LABY, R. J.
(Department of Plant Pathology, Cornell University, Ithaca, NY 14853, U.S.A.)

Hrp[-] mutants of *E. amylovora* deficient in pathogenicity and the ability to elicit the hypersensitive reaction (HR) were created by lambda-Tn*10* mutagenesis. Members of a cosmid library containing wild-type DNA of *E. amylovora* were mobilized into selected Hrp[-] mutants. Cosmids that restored pathogenicity to the mutants were self-selected on immature pear fruit and then tested for HR elicitation on tobacco. Previously identified cosmids restored pathogenicity and HR-eliciting ability only to three to nine specific transposon-induced mutants of *E. amylovora*. A recently identified cosmid, pCPP430, restored these properties to all 18 transposon-induced Hrp[-] mutants (and two naturally occurring mutants). Further work showed that pCPP430 contains a cluster of *hrp* genes, dispersed throughout a 45 kb region of chromosomal DNA.

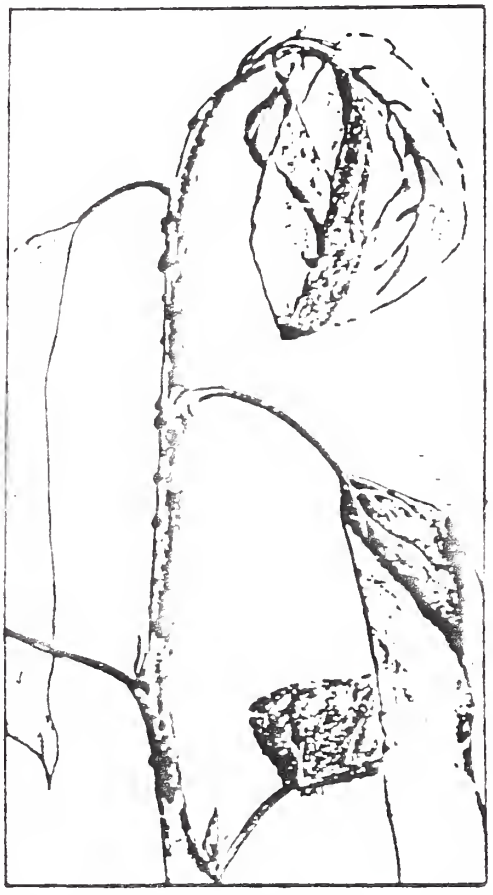
Escherichia coli DH5 (pCPP430) elicited an extremely rapid and strong collapse of tobacco leaf tissue following infiltration. In addition, the cosmid conferred HR-eliciting ability (in tobacco), to several other species of *Erwinia*. The reaction of immature pear fruit to inoculation with several species of *Erwinia* was altered by the presence of pCPP430.

These results clearly indicate that pCPP430 contains all the genes needed for elicitation of the HR, and that these genes are expressed in *E. coli* and in other *Erwinia* species.

Fifth I.S.H.S. International Workshop on

FIRE BLIGHT

ABSTRACTS



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RESEARCH STATION of GORSEM
UNIVERSITY CENTRE of LIMBURG

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Section 1 : Spread, detection and quarantine

Chairman : T. VAN DER ZWET
Co-chairman : J.-P. PAULIN

In Autumn 1984, symptoms characteristic of fire blight were observed in a single pear orchard of Passa-crassana variety in Archadia District, in central Peloponnese. The development of the disease in this area has been closely followed and the correlation between the weather conditions and the evolution of the disease is attempted. The next spring the disease was observed in the island of Crete on Passa-crassana variety, in the island of Cefalonia on Kondula variety and in an isolated area in Northern Greece on General LeClerk variety. In 1986 a new focus of the disease was located in the island of Lesbos again on Passa-crassana variety. The year 1987 was the year for fire blight spreading in Greece. During that year the disease was observed in most of the pear growing areas in Greece. The disease was also found on some other hosts including apples, quinces, mespillus and wild pears. *Erwinia amylovora* was isolated in all cases and the pathogenic ability of the isolates was verified. The morphological, physiological and biochemical characteristics of representative isolates of the bacterium from different localities and hosts have been studied, and compared with that of reference strains. The serological reaction with antisera prepared against reference isolates was also studied. From the results obtained it can be concluded that fire blight in Greece is a serious problem and the causal bacterium [illegible] to the characteristics of the type strain.

DISTRIBUTION OF FIRE BLIGHT IN MEXICO AND THE IDENTIFICATION OF THE BACTERIA ON PEAR AND PYRACANTHA

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The first reports of fire blight in Mexico appeared in 1957, when it was observed around Mexico City. On the basis of official reports and field observations the disease is now distributed in all the pear and apple growing regions of Mexico. These are in the States of Chihuahua, Durango, Zacatecas, San Luis Potosí, Jalisco, Michoacán, Puebla and Mexico, for pears. The same applies to apple except that it has not been reported from Sur and Jalisco. In some parts of the States of Chihuahua and Mexico accurate estimates of losses are lacking. Fire blight of pear and pyracantha has been endemic in the State of Mexico, Cuautitlán region, for many years. Koch's postulates were fulfilled with pyracantha isolate on flowers and the bacteria were identified as *Erwinia amylovora*. Biochemical tests for pear isolate were the same as the pyracantha isolate.

FIRE BLIGHT IN NORWAY

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Fire blight was detected for the first time in Norway in 1989. It was a limited outbreak, confined to a rural area and the suburbs of a city on the west coast of the country. Different species of Cotoneaster were attacked most seriously the broad leaved species. Infection on apple or pear was not found. An eradication programme was started and has been continued for three years. An important conclusion to be drawn from the campaign is that it is almost impossible to eradicate fire blight once it has entered the private gardens in a suburb. However, the effort to prevent the disease to enter nurseries and to spread to other parts of the country has so far been successful.

Five years [illegible]
Shaul E. [illegible] Department of Plant Path[illegible] A[illegible] Center
Herzog Z., Department of Plant Protect[illegible] [illegible] Agric[illegible]

Erwinia amylovora was recovered [illegible] from a young (four-year-old) pear orchard [illegible] Valley, the Galilee, within three weeks of the disease's [illegible] in four other orchards [illegible] the coastal plain, about 200 km south of the first. During the summer of 1986 *Erwinia amylovora* was found [illegible] with detection of this aggressive new disease we were faced with the dilemma what procedures to use to contain the spread of *Erwinia amylovora*. The initial impulse was to eradicate the first infected orchards where fire blight was noticed. This idea was abandoned when additional contaminated orchards were found during May and June 1986.

In April 1986, the disease was detected at eight new sites scattered in the country, including a pear orchard in the Negev desert in the south. Fire blight infections were also noticed in the Galilee. The spring of 1987 was not favorable for fire blight, resulting in very low incidence of the disease in previously infected pear orchards. Nevertheless, fire blight infections were found in six new sites, three pear orchards and three apple orchards, planted with susceptible cultivars (Golden Delicious and 'Starkrimson'). In 1988, *Erwinia amylovora* caused heavy infections in pear orchards in the north on a site detected and in three orchards located in a new region for fire blight in the northern coastal plain. In the south the disease was not detected in two pear orchards infected in the past. The spring of 1988 was not favorable for the disease, resulting in very low incidence of the disease in some of the orchards from which *Erwinia amylovora* had been detected in previous years.

UTILISATION OF RAT MONOCLONAL ANTIBODIES TO DETECT *ERWINIA AMYLOVORA*

Rat monoclonal antibodies against *Erwinia amylovora* have been prepared. Different [illegible] were compared with the available polyclonal antibody. Comparisons were made of pure bacterial cultures and [illegible].

The advantages and disadvantages of the method used to detect the bacteria are discussed.

Hutcheon, J. [illegible]
Faculty of [illegible]

DETECTION OF *ERWINIA AMYLOVORA* FROM APPLE TISSUE BY DNA HYBRIDISATION

Craig A. Beer and Rosemary G. Clark
Plant Diseases Division, DSIR, Auckland, New Zealand

A DNA hybridisation method, using a ^{32}P-labelled probe allows detection of [illegible] populations /10^2 colony forming units/cely/ of *Erwinia amylovora* from apple calyx tissue. The method has been [illegible] quarantine inspection procedures that regulate [illegible] of apples that may not disseminate fire blight.

THE FIRE BLIGHT SITUATION IN CZECHOSLOVAKIA IN 1986-1988

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Fire blight has been found for the first time in 1958 at Usti. The presence of Erwinia amylovora /Ea/ was confirmed on Crataegus trees and Cotoneaster shrubs at four sites in the public parks of Prague city. In 1987, the disease was discovered not only on Crataegus /15 sites/ and Cotoneaster /1 site/ but also on Malus and Pyrus /1 tree each/. All the plant samples in which Ea was confirmed to be present came from the territory of Prague and the closest vicinity of the city. During 1988, new fire blight outbreaks were found at 162 sites. The current status of that disease is presently distributed in the central and northwest Bohemia. The plants affected were species of Crataegus /94 %/, Pyrus /3 %/, Malus, Pyracantha, Cydonia and Chaenomeles /0.5-1 % each/. In one case the disease occurred in the pear nursery. Fortunately, it wasn't found in intensive apple or pear orchards.

HISTORY OF FIRE BLIGHT IN FRANCE 1971-1988

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Vincent P. Service Central de la Protection des Végétaux, Paris, France

Fire blight disease was first recorded in the north of France on hawthorns cultivars in 1971. Afterwards and on an unexpected manner the bacterial pathogen was detected in south-west of France on pear trees in 1978.
During the seasons 1982 and 1983 fire blight was reported in Paris area and in the "Val de Loire". Since the appearance of the first symptoms, the Plant Protection Service has identified all the affected host plants detected by prospection. This statement gives a rather good idea of the relative susceptibility of genus, species and varieties to that bacteria.
The legal procedure described in the paper concerning territory survey, control of commercial exchanges profilaxy and eradication measures have widely contributed to limit the geographical disease progression.
In 1988 first symptoms were observed during early spring on pear trees in the south-west of France. The foreseen occurence of secondary blossom period specially on pear cultivar "Passe Crassane" during May and June must incite to a great vigilance.

THE POTENTIAL VULNERABILITY TO FIRE BLIGHT OF PEAR AND APPLE CROPS IN THE GOULBURN VALLEY, VICTORIA, AUSTRALIA

Satish C. Wimalajeewa, Plant Research Institute, Department of Agriculture and Rural Affairs, Burnley, Victoria, Australia, and Kerry Atley, Cropwatch, Shepparton, Victoria, Australia

Although Australia has hitherto remained free of fire blight the risk of it being introduced into the country is now increasing owing to the increasing volume of pome fruit propagating material imported into the country, especially illegally, from countries having fire blight. The practice of the use of apple fruit from some of these countries commercially as a consideration may also contribute to this risk, though to a small extent. To ascertain the potential impact of fire blight on the pome fruit industry in Australia, especially the pear and the apple, we carried out a study to assess the potential vulnerability of the pome fruit crops in the Goulburn Valley in Victoria, where a major proportion of the pear industry in Australia is located. Published [illegible] were used in this assessment. Results indicate that conditions conducive to severe fire blight [illegible] and frequently during the blossoming period. In a three [illegible] there were 13.5 simple infection days and 5.7 [illegible] of the locations in this region. It is concluded that a high degree of [illegible] of the pears grown in the Goulburn Valley [illegible] fire blight susceptible cultivar Williams' Bon Chretien (Bartlett) and the apple fruit here would be highly vulnerable to fire blight [illegible] into the country.

EPIPHYTIC COLONIZATION OF FLOWER AND LEAF SURFACE OF PEAR TREES IN A COMMERCIAL ORCHARD

Charles MANCEAU, Jean-Claude LALANDE, Gérard LACHAUX, Hélène CHARTIER and Jean-Pierre FAULIN

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In 1988, 200 hundred flowers and 500 hundred leaves were collected weekly in a commercial Passe-Crassane orchard with an history of fire blight since 1984. Bacterial populations were monitored by washing organs with distilled water and plating serial dilutions on King's B medium. A special regard was applied to E. amylovora, E. herbicola, P. syringae, P. fluorescens and yellow pigmented pseudomonads. E. amylovora was never recovered from healthy flower as well as from healthy leaves throughout the growing reason with the exception of leaves located just under active oozing symptoms. E. herbicola and P. fluorescens were detected from time to time and sporadically in the orchard on flowers and leaves. Conversely, P. syringae and yellow pigmented pseudomonads were detected early on flowers. The populations increased during bloom period and spread all over the sampling plots. Thereafter their populations were detected on almost each sampled leaf and remained at high level (10^{4} to 10^{5} c.f.u./leaf) during all the growing season. These result confirm that E. amylovora have not an epiphytic fitness in its biological cycle under our condition, either on flower or on leaf. P. syringae and yellow pigmented pseudomonads are better epiphytes than E. herbicola and P. fluorescens and could be good candidates as potential biological control agents, provided some antagonistic bacteria can be found among them.

[illegible]

[illegible]

[illegible]

Two aspects of the relationship between fire blight development and pruning were taken from the principle of infection and development of fire disease or branches cut with a contaminated knife were assessed. Second the efficiency of different methods for disinfecting knives were evaluated.

The author will present results of several and separate trials conducted for the last eight years on experimental fields in DAL.

DETECTION AND ELIMINATION OF ERWINIA AMYLOVORA ON PEAR AND APPLE TISSUES. Ton van der Zwet and Krzysztof J. Janisiewicz, U.S. Department of Agriculture, ARS, Appalachian Fruit Research Station, Kearneysville, West Virginia, USA

Apple and pear fruit, located at different distances to active shoot blight, were examined internally and externally for the presence of Erwinia amylovora. The survey was conducted in 3 U.S. states and Ontario, Canada. The bacterium was not recovered from the core tissues of blight affected fruit collected from blight-free trees or from fruit situated at least 1.0 m distant from visible symptoms. However, E. amylovora was consistently isolated from the surface of pome fruit collected from blighted trees, and occasionally from symptomless trees. Only 1% of surface sterilized apples, collected from a heavily blighted tree, and fruit in cold storage for 4 months, developed blight symptoms, as compared to 15% of fruit from blighted trees. Meticulous fruit from 2 symptomless orchards in Washington [illegible] E. amylovora. All epiphytic bacteria were eradicated with [illegible] of the following chemicals plus 0.5% Orthe X-77 surfactant.

[illegible] A SPECIFIC METHOD FOR THE DIAGNOSIS OF FIREBLIGHT

[illegible] Peter Bellemann, Wolfgang Zeller und Klaus Geider

[illegible] und Forstwirtschaft, Institut für [illegible] Max-Planck-Institut für [illegible] Abteilung Molekulare Biologie, Heidelberg

[illegible] a method increasingly used in the diagnosis of [illegible] e.g. the bacterium Erwinia amylovora [illegible]. Recently a new variant of this method has been developed which is faster and more easily to use than the conventional tests and it requires no radioactive substances. In the present the advantages and disadvantages of DNA-hybridization (radioactive and nonradioactive) in contrast to immunofluorescent labelling are being discussed. The sensitivity of these different methods are compared providing essential information on their optimal usage.

ISOLATION OF LYTIC PHAGES OF *E. AMYLOVORA*. Joel L. VANNESTE, Jean-Pierre PAULIN. INRA Pathologie Vegetale Beaucouze 49 000 Angers France

A set of lytic phages of *E. amylovora* were isolated from sewage and soil from fire blight infested orchards. The ability of these phages to produce plaques had been tested on i) 228 strains representative of the genera of plant pathogenic bacteria, ii) 60 strains of epiphytic bacteria isolated from fire blight host-plants, iii) 22 non *E. amylovora* strains isolated with *E. amylovora* from fire blight lesions. Only *Erwinia* strains were sensitive to the phages isolated. Of 22 *E. herbicola* strains tested 8 were sensitive to one or several phages but none of these strains were sensitive to all of them. The host range of 175 strains of *E. amylovora* tested 161 were sensitive to all the phages whereas the others were sensitive to at least one phage. The specificity of this set of phages for *E. amylovora* has been used in the laboratory, along with other diagnostic tests to confirm the identity of this bacterium.

SOME UNANSWERED QUESTIONS IN FIRE BLIGHT RESEARCH

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Many concepts in fire blight research rest on probabilities and possibilities rather than on certain knowledge. This means that assumptions must be reassessed critically at regular intervals, alternative possibilities considered and fire detail explored. Questions need to be carefully framed and broad questions broken down into a series of precise ones (where, when, what, which, why and how). Some questions cannot be answered and it is important to state clearly what is not known, to distinguish subjective from objective views and to distinguish possibilities (based on limited evidence) from probabilities (backed by good evidence). Fire blight epidemiology and host-parasite relationships will be used to explore questions which seem most urgently in need of answers in the interest of disease control.

Section 2 : Epidemiology and prediction

Chairman : S. Thomson
Co-chairman : E. Stadt

THE HONEYBEE AS A POSSIBLE VECTOR OF ERWINIA AMYLOVORA (BURR.) WINSLOW ET AL.

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The longevity of E. amylovora has been investigated systematically in all parts of the beehive as well as in bee corpuses and in bee intestines.
The maximum longevity period is 11 weeks for nectar and 6 weeks for honey. These results can only be reached at a conservation temperature of 4°C. At the higher temperature of 35°C, E. amylovora can survive only two weeks in sugar solution. Debris, wax and propolis are bad conservation media for E. amylovora.
The maximum longevity on wax is 3 weeks at 4°C. Regardless of the conservation temperature, E. amylovora can survive no longer than 1 day in debris and propolis.
In pollen E. amylovora can keep alive for a longer time at low temperature (2 weeks at 18°C and more than 50 weeks at 4°C). At 35°C the bacteria die during the first week after inoculation. Erwinia-bacteria survive less than two days in or on the honeybee. We can conclude that an experimental circulation of bees can spread locally a present infection when visiting the flowers.
Coming from a colony which was infected before winter, bees can be a source of infection when visiting flowers in spring. Bee colonies originating from an infected area emerge from hibernation [illegible] free.

A WARNING SYSTEM FOR FIRE BLIGHT ON PEARS IN BELGIUM : PRELIMINARY NOTES AND PRACTICAL PROSPECTS

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A three years'study has been made in several Belgian orchards from 1982 to 1984 in order to assess the influence of phenology on fire blight development. From the data collected in a Duchesse pear orchard near Brussels during this period a model has been built to adjust existing warning systems to the conditions prevailing in Belgium and to add phenological features to the usual climatological ones. The model consists of three successive stages : assessment of risks of disease establishment, calculation of incubation time, determination of symptoms expression. Every day, the simulation expresses the relative number of infected flowers, shoots and pears and the relative quantities of symptoms resulting from previous infections. To judge its validity the model has been applied to other orchards of the same cultivar for a wider period. A brief description of the model and a few examples are presented here. The comparison between simulation and actual observations indicates a quite good agreement in the dates of appearance and the quantities of symptoms, in spite of a lack of parameters and inaccuracy of some measurements. The model has to be improved in the next years owing to additional data and it could then be used as a basic system for fire blight control.

MICROPROCESSOR-BASED ORCHARD ENVIRONMENT MONITORS AND FIRE BLIGHT RISK ASSESSMENT

Constance M.E. Garrett and Diana A. Fletcher
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Comparisons have been made at East Malling of fire blight risks as assessed by the Billing revised system (1984) and two orchard monitors, the American Reuter-Stokes RSF and the Paar KMS-F. The monitors assess risk from environmental factors only and the three systems use slightly different criteria. The RSF output indicates the level of fire blight risk (nil, low, medium, high) but the Paar KMS-F identifies each day simply as either a risk day or not. The effect of the instrumentation and its housing on temperature, rainfall and RH values will be demonstrated and the relative value of the types of risk assessment will be discussed.

[illegible] Alexandrine [illegible] Bundesanstalt, Fasanerieallee [illegible] Fed. Rep. of Germany

The Billing system for fire blight risk assessment was applied in the present study to evaluate the epidemic nature of the severe outbreaks of pear fire blight that took place in Egypt during the period of 1984-1986. Results have indicated great risk for disease infection since high concentration of the epiphytic bacteria (Erwinia amylovora) was detected to occur during blooming of pear trees. It was thus essential to apply several sprays at short intervals with streptomycin or any other effective chemical (Ali-Niazee, 1979) sprays to obtain a successful control for fire blight in pear orchards of Alexandria and Behera Governorates where the disease has been established.

FIRE BLIGHT CONCEPTS AND A REVISED APPROACH TO RISK ASSESSMENT

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Risk assessment systems are based on concepts concerning fireblight epidemiology. If the concepts of the designer differ from those of the user, problems may arise in the use of the system. Billing's original risk assessment system has been revised in the light of experience. Concepts underlying the current approach and reasons for change are indicated. Schouten's (1987) table of PI values [illegible] which makes spring modifications unnecessary. The infection risk scoring method has been revised and I-periods (I-points) are no longer started on wet days in cold weather. The graphical presentation is greatly simplified. So far, the revised system has reflected [illegible] to a useful degree. It is easier to use than the original system and is more suitable for use in warm or subtropical [illegible]. As before, account must be taken of local field factors.

THE EDITION AND PRELIMINARY EXPERIMENTATION OF A COMPUTERIZED WARNING SYSTEM FOR THE CONTROL OF FIRE BLIGHT

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[illegible] of a computerized warning system aimed at fire [illegible] has been previously described (JACQUART et al, 1984). The basis of this system will be presented more precisely. It uses as input pheno-[illegible] phenology, inoculum level, past and forecasts climatic data. The warnings provided are : no action, [illegible] and removal of symptoms, spray of chemicals.

This warning system has been tested in contaminated areas in France : Batas, Anjers, Dax, for pear orchards, during 2 or 3 years.

The informations collected during these experimentations show at present that :

- the inputs used in the system are quite easily found, but they need to be specially collected at the orchard level. In the 3 sites under observations, the meteorological forecasts have been found to be fairly good for temperatures and for rain occurence, less accurate for rain amount and storm occurence and generally speaking precise enough for our requirement,
- the outputs are in general agreement with the observed activity of the disease in the orchards.

Several improvements and modifications have been introduced after these experimentations, mainly in the estimation of the [illegible] potential in post bloom period, and for the infection risks during the same period. Besides, the calculation of PI according to STEINER, (1988) for the estimation of bacterial multiplications has been introduced.

Nevertheless, the low level of activity of fire blight during the last 3 years in France has not allowed a test of the efficiency of the control obtained with the help of this warning system in the orchard as compared to a standard spray schedule, in [illegible] conditions.

PREDICTING APPLE BLOSSOM INFECTIONS BY ERWINIA AMYLOVORA USING THE MARYBLYT MODEL. Paul W. Steiner, Botany Department, The University of Maryland, College Park, MD 20742, USA.

MARYBLYT is an empirically derived comprehensive model for fire blight disease management that anticipates, identifies, and predicts symptom appearance of four primary types of infection: blossom, canker, shoot and trauma blight. The blossom blight submodel follows the ecology characterized by Thomson (1986, Phytopathology 76 476) for apples, coupled with the dynamics of epiphytic inoculum potential determined by Zoller, et al. (1979, Phytopathology 69 1050) for pears. Blossom infections occur only when five strict requirements are met: (1) blossoms must be open, (2) accumulation of at least 110 degree hr >18.3C from full pink or 72 degree days (DD) >12.7C from green tip; (3) a wetting event as rain >=.25 mm or dew today or >=1.5 mm yesterday, (4) an average daily temperature >=15.6C; and (5) all of the above in the sequence shown. Early symptoms appear with the accumulation of an additional 50 DD 12.7C after infection which, depending on the prevailing temperatures in our studies, has occurred anywhere from 5 to 25 calendar days.

PREDICTING CANKER, SHOOT AND TRAUMA BLIGHT PHASES OF FIRE BLIGHT EPIDEMICS USING THE MARYBLYT MODEL. Paul W. Steiner, Botany Department, University of Maryland, College Park, MD 20742, USA.

MARYBLYT is a comprehensive model for predicting all phases of apple fire blight epidemics associated with blossom, canker, shoot and trauma infections. The onset of overwintering canker activity (OCA) is coincident with the accumulation of 21.1 degree days (DD) >12.7C from green tip (GT) and can be confirmed by color changes in the sapwood at canker margins. In 28 of 28 site-years of epidemics that had a threshold was achieved only after petal fall, indicating that cankers are not usually a major source of inoculum for blossom infections. Canker blight symptoms (CBS) associated with the systemic invasion of bacteria into shoots and limbs adjacent to active cankers either occur regularly with the accumulation of 222 DD >12.7C after GT. If summer pruning wounds are present when CBS occur, then shoot blight symptoms (SBS) can be expected at 170.2 DD >12.7C after GT. A similar 50 DD interval between infection and symptoms is [illegible] blight. Trauma blight incidents of hail [illegible] which occur after the accumulation of at least 111 degree hours (DH) >18.3C.

COMPUTERIZATION OF BLOSSOM BLIGHT PREDICTION MODEL. Gary Lightner, U.S. Department of Agriculture, ARS, Appalachian Fruit Research Station, Kearneysville, WV, and Paul W. Steiner, Department of Botany, University of Maryland, College Park, MD, USA.

A computerized version of the MARYBLYT fire blight predictive system has been developed. The program requires data inputs of minimum and maximum temperatures, rainfall, and several phenological benchmarks. In addition to the basic computation of several potentials governing infection periods and symptom development, the program allows the user to easily perform "what if" analyses. The infection risk for any number of days may be predicted based on weather records or any source the investigator wishes to use as input. The software is designed to run on an IBM compatible personal computer. Data can be displayed and edited on the screen or output to a printer. The system has been developed with data collected from fourteen states across the United States. Early research versions include several "toggle" options controlling infection temperature and inoculum thresholds to be varied by the investigator.

EVALUATION OF THE MARYBLYT MODEL AND THE BILLING SYSTEM FOR FIRE BLIGHT RISK ASSESSMENT. T. van der Zwet, G. Lightner, and J.C. Walter, U.S. Department of Agriculture, ARS, Appalachian Fruit Research Station (AFRS), Kearneysville, WV, and P.W. Steiner, Botany Department, University of Maryland, College Park, MD, USA.

The Maryblyt model was compared with the Billing system for blossom blight infections at AFRS for 1984 through 1988. Temperature and rainfall data, combined with calculations of overwintering canker activity (OCA) and epiphytic inoculum potential (EIP), were plotted with a previous research model, presented at the 1986 workshop (A.H. 217:139). Infection risk periods, based on the Billing revised system (RS) of potential daily doublings (PD) of Erwinia amylovora, were plotted between the graphics and the four basic requirements of the Maryblyt model. Comparing years with severe, light, or no fire blight indicated a close correlation between the RS and Maryblyt model. However, the additional parameters included in the Maryblyt model allow specific infection periods to be identified.

VIRULENCE FACTORS OF *Erwinia amylovora*

Klaus Geider, Hildegard Bauersfeind, Petra Bernhard, Nicole Jane Thomas, Schwartz, Richard Theiler and Frank Bernhard
(Max-Planck-Institut für med. Forschung, Jahnstr. 29, D-6900 Heidelberg, FR

Cloned fragments of a common 29 kb *Erwinia amylovora* plasmid were used for the identification of the fireblight pathogen in field isolates. A fragment of the replication origin inserted into a pBR-plasmid caused the mutation of virulent pEA29-causing retardation of virulence symptoms observed for pear shoots or pear seedlings (with W. Zeller). For ooze production of immature pears and for bacterial spread on a lawn of cultured pear cells. Inactivation of the *rpoA* gene of *E. amylovora* could result in mutants with altered defense reactions. By [illegible] DNA of *E. amylovora* could restore wild type properties for the *rpoA* mutant and for the avirulent mutant P66 and 5 Dihydrophenylalanine is synthesized by a virulent and an avirulent *E. amylovora* strain but it is lacking in many other strains. This amino acid is presumably not a virulence factor rather than a necrosis factor for plant cells. Cloned genes from *E. carotovora* subsp. *atroseptica* encoding cellulase and pectate lyase had no homology to genomic DNA of *E. amylovora*. The genes were expressed in *E. amylovora* and the products released by cell lysis causing a prolonged bacterial cell metabolism on inoculated pear cells.

Section 3 : Physiology, genetics and biochemistry

Chairman : S.V. BEER
Co-chairman : J.L. VANNESTE

Calcium and Potassium nutrition and susceptibility to fire blight

(*E. amylovora*) of Pyracantha cv. "Mohave"

Francis LEMAIRE
Station d'agronomie

Jean-Pierre PAULIN
Station de Pathologie végétale et Phytobactériologie

Alain CAO
Laboratoire d'Analyses [illegible]

Christophe COUMEAU
Service d'agronomie

[illegible]

[illegible] plant and particularly [illegible] cutting [illegible] different [illegible] period of the plant [illegible]

[illegible] growing media on decreasing the susceptibility [illegible] potassium contents [illegible] Ca increasing the susceptibility [illegible] of high Ca levels.

ERWINIA AMYLOVORA INFECTION OF PANICLES OF PYRACANTHA. Mark-Wilson, Harry A.S. Elliot & David C. Sigee. Dept. of Cell and Structural Biology, Stopford Building, The University of Manchester, Manchester, M13 9PT, U.K.

Epiphytic [illegible] of host plants maintained in the laboratory under controlled conditions were inoculated on single sites [illegible] tissues of anthers, with *E. amylovora*. Pathogen population changes in the flowers [illegible] were quantified. Multiplication of the strain was biphasic, with an epiphytic phase preceding tissue invasion. At first the pathogen did not invade the stylar tissues, under humid conditions bacterial cells were carried out on the exudate of the stigma or stigmatic exudate. The nectary represented the main site of pathogen multiplication and invasion under humid conditions, with early multiplication occurring in the nectathodes and subsequently [illegible] chamber prior to nectarial invasion. Multiplication on the surface of the anther was limited, except in the [illegible] of the cells [illegible] zone, through which invasion occurred. Within the anther locule, rapid bacterial multiplication led to complete [illegible] of the pollen grains. These results are of relevance to the epidemiology of fire blight disease.

MECHANICAL PRESSURE OF *ERWINIA AMYLOVORA* IN RELATION TO WATER POTENTIAL AND ITS POSSIBLE ROLE IN PATHOGENESIS. *Henk J. Schouten*, Department of Phytopathology, Wageningen Agricultural University, P.O. Box 8025, 6700 EE Wageningen, the Netherlands

Experiments showed that the extracellular slime of *Erwinia amylovora* consisting mainly of EPS, swells strongly with increasing water potential. When bacterial slime is accumulated in the intercellular holes of the host plant and the water potential rises suddenly, for instance due to a rain shower, the slime will swell strongly. If that slime cannot escape, it will exert a pressure on the surrounding plant cells. The 'swelling pressure' can rise to the level of the water potential change (up to 3 MPa). This swelling pressure may lead to compression of soft host cells and to formation of large slime-filled holes in the plant's tissue. Moreover, the swelling slime may force its way to the outside of the plant (exudation) or to healthy parts. The slime may also perforate cork barriers formed by the plant after infection, if the mechanical pressure is high and if the cork barrier is incomplete or not yet fully developed, so that girdling is prevented. Growth of bacteria and subsequently increase of the extracellular slime may induce a pressure too. The maximum value of this 'growth pressure' equals the water potential at which bacterial growth attains its limit minus the actual water potential.

STUDY OF THE INTERACTIONS BETWEEN *E. AMYLOVORA* AND PLANT TISSUE
THE USE OF ELECTROLYTE LEAKAGE

Marie-Noelle BRISSET, Jean-Pierre PAULIN

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The measure of electrolyte leakages from plant tissues allow the characterization of different plant-bacteria interactions. After vacuum infiltration of the cells with the bacterial suspension, leaf discs were incubated in sucrose buffered conditions and the electrolyte leakages were monitored from time to time during 47 hours. Different patterns of leakage were obtained depending on the type of plant bacteria interaction. We were able to distinguish compatible situations (*E. amylovora*/pear, *P. phaseolicola*/bean) from incompatible ones (*E. amylovora*/bean, *P. phaseolicola*/pear) or indifferent situation (*E. herbicola* on both).

In the case of fire blight, electrolyte leakage assessment could be a convenient technique for several purposes :

- study of aggressivity or virulence of strains (wild-types or mutants)
- study of susceptibilities of plant genotypes
- study of molecules as ? (such as carbohydrates) disease

POPULATION DYNAMICS OF NONPATHOGENIC MUTANTS OF *ERWINIA AMYLOVORA* IN APPLE HOST TISSUE

John L. Norelli, Matthew T. Gilbert, Herb S. Aldwinckle, Cathy H. Zumoff, and Steven V. Beer
Cornell University, Geneva and Ithaca, NY 14456 and 14853, USA

Transposon Tn*5* mutants of *E. amylovora* were screened for their ability to cause fire blight symptoms on inoculated immature pear fruits (Path), cause a hypersensitive response in tobacco leaves (HR), produce slimy colonies on minimal media (produce exopolysaccharide, EPS), and grow in apple shoots following inoculation of cut leaves. The populations of all strains declined in apple shoots 6 hr after inoculation. From 1 to 6 days following inoculation, the populations of Path$^+$/HR$^+$/EPS$^+$ mutants and the wild-type strain CFBP 1232 increased, the populations of Path$^-$/HR$^-$/EPS$^+$ mutants and the saprophyte *Erwinia herbicola* remained relatively constant, and the populations of Path$^-$/HR$^+$/EPS$^+$ mutants and Path$^+$/HR$^+$/EPS$^-$ mutants and the incompatible pathogen *Pseudomonas syringae* pv. *tomato* decreased.

A [illegible] ISOLATED ON THE EPIDERMIS OF *ERWINIA AMYLOVORA*

A. [illegible]
[illegible]
I.N.R.A. Station de Pathologie Végétale - INRA, Beaucouze, Fr 49000 Angers, France

[illegible] isolated on agar both virulent and avirulent [illegible] the cell envelope of the role that [illegible] by [illegible] virulent variants in the [illegible] the [illegible] as well as the [illegible] the [illegible]

A NON CAPSULATED AND AVIRULENT ISOLATE OF *ERWINIA AMYLOVORA*

Alberto Mendoza Herrera and Jean-Pierre Paulin
Universidad Autonoma de Nuevo Leon, Mexico
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During the study of the link between cellular envelope and virulence of *Erwinia amylovora*, a strain isolated from a [illegible] virulence but with an encapsulated cell was found. The capsule is [illegible] of cell capsulates but in which [illegible] of cells encapsulated.

DETECTION AND CHARACTERIZATION OF AN IRON UPTAKE SYSTEM IN *E. AMYLOVORA*

Jean L. VANNESTE, Dominique EXPERT, Pathologie Végétale INRA-PG rue C. Bernard, 75231 Paris Cedex 05, France

We found that strain 1430 of *E. amylovora* could grow under iron limited conditions, suggesting that this strain possesses an efficient iron assimilation mechanism. Production and excretion of a siderophore by 1430 was detected on petri dish by the [illegible] devised by Schwyn and Neilands. The chemical nature of the siderophore, hydroxamate or catechol, was then characterized by colorimetric assays : test of Csiaky and test of Arnow respectively. Only an hydroxamate activity was detected in the supernatant of low iron cultures. In addition, we found by SDS-PAGE that two proteins of the outer membrane, with a molecular weight of approximately 84 000 d and 76 000 d, were over-expressed under iron limited conditions. Such low iron inducible proteins are known to be receptors for iron siderophores. Thus, one of these proteins might be the receptor for the hydroxamate siderophore produced by 1430.

PUTATIVE ROLE OF SIDEROPHORE IN THE VIRULENCE OF *ERWINIA AMYLOVORA*

Barbara J. Sneath, John M. Hevesi, and Steven V. Beer
Department of Plant Pathology, Cornell University, Ithaca, NY 14853 USA

Mutants of *Erwinia amylovora* created by transposon mutagenesis were assayed for loss of pathogenicity and reduced virulence on immature pear fruit. Approximately 1,000 colonies were screened for siderophore production on plates as described by Schwyn and Neilands [Anal. Biochem. 160:47-56 (1987)]. Of 81 mutants tested, 11 were affected in the amount of siderophore produced compared to the wild-type strain. One mutant, Ea321(Tn*5*), reduced in virulence and producing approximately half the level of extracellular polysaccharide, was complemented with members of a wild type cosmid library. Two cosmids were identified that restored siderophore production, as assayed on Chrome Azurol S-Neilands medium. The four cosmids also restored virulence on immature pear fruit to the mutant. Further studies of the siderophore, the mutants, and the complementing cosmids are underway.

SENSITIVITY OF ERWINIA AMYLOVORA TO HIGH TEMPERATURES - POSSIBLE USE OF HEAT TREATMENT FOR PLANT PROPAGATION MATERIAL

Marianne Keck[1]; Roland Chartier[2]; Walter Zislavsky[1]; Jean-Pierre Paulin[2]

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Erwinia amylovora is not a very resistant bacteria to heat treatments. Using 11 strains of different origins we have checked that a rapid decrease of bacterial populations occurred at temperatures higher than 30°C; all cells being killed in 24 hours at 40°C (constant temperature) in pure cultures. Sensitivity to such treatments has been investigated for pome fruit scions of several cultivars (pears and apples). Preliminary results show a certain lethal effect on Erwinia amylovora inside plant tissues by this range of temperatures.

[illegible] OF VIRULENCE OF *ERWINIA AMYLOVORA*
[illegible] Plant Sciences, University of Bath, Bath, U.K.

TRANSPOSON MUTAGENESIS OF *ERWINIA AMYLOVORA*

Peter Bereswill, Norbert Jank, Richard Theiler, and Klaus Geider
Max-Planck-Institut für Molekulare Genetik, Ihnestr. 29, D-6900 Heidelberg, FRG

We have mutagenized *Erwinia amylovora* strain Ea174 with transposons located on the Tn*3*-like element of *Agrobacterium tumefaciens* and on mobilizable pER-plasmids of *Escherichia coli*, which are suicide vectors for this strain. Out of 2000 Tn*5* mutants, 11 were unable to produce virulence symptoms on pear slices and on pear seedlings. Except one mutant, which required leucine, all others were prototrophic. They could be classified by the *Eco*RI fragment carrying the transposon (1.0, 4.0, 5.2, 6.5, 10.5 and 11 kb, respectively) and no deficiency was observed in bacterial motility, EPS-synthesis or sugar utilization. Eight of 10 mutants did not propagate phage 41. Fragments with the transposon insertion were cloned and caused avirulence when transferred to wild type strain. Insertion of transposon Tn*4431*, which carries structural genes for bacterial bioluminescence, into mutants responding to constituents of pear cells in order to produce light. Some of them were altered in virulence. Bioluminescence was restricted to certain conditions of bacterial growth environment like the viability of the feeding pear cell.

A CLUSTER OF PATHOGENICITY GENES FROM *ERWINIA AMYLOVORA* ENABLES *ESCHERICHIA COLI* TO ELICIT THE HYPERSENSITIVE RESPONSE

Steven V. Beer, Cathy H. Zumoff, David W. Bauer, Barbara J. Sneath, and Ron J. Laby
Department of Plant Pathology, Cornell University, Ithaca, NY 14853 USA

Hrp$^-$ mutants of *E. amylovora*, deficient in pathogenicity and the ability to elicit the hypersensitive reaction (HR), were created by lambda-Tn*10* mutagenesis. Members of a cosmid library containing wild-type DNA of *E. amylovora* were mobilized into selected Hrp$^-$ mutants. Cosmids that restored pathogenicity to the mutants were self-selected on immature pear fruit and then tested for HR elicitation on tobacco. Previously identified cosmids restored pathogenicity and HR-eliciting ability to only a few mutants. In contrast, the recently identified cosmid, pCPP430, restored these properties to all 18 transposon-induced Hrp$^-$ mutants and two spontaneous Hrp$^-$ mutants. Further work showed that pCPP430 contains a cluster of *hrp* genes dispersed throughout a 45 kb region of chromosomal DNA. *Escherichia coli* DH5(pCPP430) elicited extremely rapid and strong collapse of tobacco leaf tissue following infiltration. In addition, the cosmid conferred HR-eliciting ability (in tobacco), to several other species of *Erwinia*. The reaction of immature pear fruit to inoculation with several species of *Erwinia* was altered by the presence of pCPP430. Thus, pCPP430 contains all the genes needed for elicitation of the HR, and these genes are expressed in *E. coli* and in other *Erwinia* species.

[illegible]
[illegible]
Ma[illegible] Fe[illegible] Pe[illegible] and Jacques Tem[illegible]
Pe[illegible] Fe[illegible] Vi[illegible] INRA 71 rue Claude Bernard
F-[illegible] Pa[illegible] (Pa[illegible] Station de Pathologie vegetale INRA
F-[illegible] Ang[illegible] France

The *Erwinia amylovora* strain CFBP1430 is a natural isolate showing a very high virulence on four different host species of fire blight. For this reason it was used to isolate avirulent mutants after transposon mutagenesis. Such mutations were obtained by using MuPR13 a phage Mu derivative which confers resistance to chloramphenicol and is complete, owing to transposition functions. 6000 independent Cm^r clones were recovered. The analysis of auxotrophs (frequency and distribution) showed that the insertions of MuPR13 were roughly random in *E. amylovora*. More than 4000 Cm^r clones were screened to detect those which were no longer able to produce exudate on apple calli (Cal$^-$ clones). Among the Cal$^-$ mutants 40 presented a unique insertion of MuPR13 and were further studied on apple and pear seedlings. Depending on their behaviour on both types of seedlings the Cal$^-$ mutants can be divided into three groups: 5 Cal$^-$ mutants are as virulent as the wild type strain, 17 showed a reduction of virulence and 24 were totally avirulent. In addition we have used another pathogenicity test on axenic grown unrooted pear microcuttings. When Cal$^-$ mutants were tested on this material the two first groups showed the same behaviour, probably because axenic pear microcuttings are more susceptible to fire blight and the third group remained unchanged proving the validity of this test to study avirulent mutants. Finally, avirulent mutants have been tested for hypersensitive response on tobacco plants. 8 of them were still able to produce HR and 16 were not. These mutants are now studied at the molecular level. Most of them appeared to be clustered in the same genomic region.

STRUCTURE OF THE EXTRACELLULAR POLYSACCHARIDE OF *ERWINIA AMYLOVORA*

Arthur R. Colvin, Robert A. Pasteur, Peter Watt*, Nicholas P. Rees and Richard C. Hamer. *Tate & Lyle Technology, London SE18 6BF and *Procter & Gamble Technical Centres Ltd., Egham, Surrey TW20 9NS, United Kingdom.

The extracellular polysaccharide (EPS) of *Erwinia amylovora* is an important virulence factor. The EPS secreted by cells recovered from culture supernatants of the virulent strain 7 grown on artificial-solid media was [illegible] by precipitation with [illegible] for 18 hrs. Extracted crude lipopolysaccharide was represented by the 2% of the polar [illegible] was purified by [illegible] on [illegible] and [illegible] followed by [illegible] and [illegible]. All with a 0-0.5M NaCl gradient. The recovered EPS contained glucose, galactose and pyruvate in a molar ratio of [illegible]. Treatment with trifluoroacetic acid [illegible] and acetate [illegible]. From this a [illegible] was [illegible] and acetate from part of the purified EPS which contained the galactose, glucose as well as acetate and pyruvate [illegible] by methylation analysis. Periodate oxidation, smith degradation analysis and evidence from [illegible] and acetolysis, the structure of [illegible] was [illegible]

[illegible]

(Part supported by [illegible] Gallaher Ltd.).

NECROGENESIS CAUSED BY (L)-(-)-2, 5- DIHYDROPHENYLALANINE IN JONATHAN APPLE SHOOT APICES. Gottfried Feistner and Robert Goodman, Stanford University School of Medicine, Stanford, CA 94305 and University of Missouri, Columbia, MO 65211, USA

The compound dihydrophenylalanine (DHP), was isolated from *Erwinia amylovora*-infected apple fruit tissue, liquid culture inoculated with *E. amylovora* (E-9) and synthesized and purified by RP HPLC. DHP was infiltrated slowly into Jonathan shoot apices at concentrations of 800, 80 and 8 ug/ml. At all concentrations tissue browning and necrosis were induced. L-phenylalanine (Sigma Chemical Co.) at these concentrations failed to induce visible signs of necrosis.

DETERMINANTS OF PATHOGENICITY TO PEARS AND ABILITY TO CAUSE THE HR IN NON-HOST PLANTS CLONED FROM *ERWINIA AMYLOVORA*

WALTERS, Karen, MAFODFI, Ali, HITCHIN, Ed. and MANSFIELD, John (Department of Biochemistry and Biological Sciences, Wye College, University of London, Ashford, Kent, TN25 5AH)

A genomic library of *E. amylovora* wild-type isolate CT1 was prepared in the cosmid pLAFR3 and mobilised into the capsulated mutant F which, unlike CT1, fails to cause fireblight symptoms in pear or the HR in beans or tobacco. Three clones were identified which restored virulence and ability to cause the HR to mutant F. Subcloning and transposon mutagenesis with Tn*lac* located the determinants restoring virulence to F on a 7.1kb *Bam*HI/*Hin*dIII fragment which was common to each clone. This fragment also restored ability to cause the HR. The three cosmid clones were also found to complement avirulent mutants of isolate CT1 recovered following treatment with nitrosoguanidine. The patterns of complementation observed indicated that a cluster of genes spanning 2. 45kb controlled pathogenicity and that these genes are not associated with EPS production.

Section 4 : Resistance and resistance breeding

Chairman : W. C. BONN
Co-chairman : M. LE LEZEC

EVALUATION OF FIRE BLIGHT RESISTANCE OF S.M. VARIETY [illegible] FOR THE PEAR CULTIVAR 'D[illegible]'

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5800 Gembloux, Belgium

In vitro regeneration of plantlets was obtained from calluses induced on roots or stems of the pear cv "Durondeau". Regenerated plantlets were micropropegated, and their progenies were submitted to an early test of resistance toward fireblight caused by Erwinia amylovora.

Plants regenerated from calluses induced on roots gave 3 clones with a peculiar behaviour when inoculated in vitro with E. amylovora: axillary buds developped from the stem basis of inoculated plantlets, producing new shoots which escaped infection.

After micropropagation, in vitro rooting, and acaptation into soil in a growth chamber, plants of these 3 clones were placed successively at 4°C during 1 month and at 24°C during 3 months, in order to induce rapid cycles of successive growth. Under those conditions, plants of two of the three clones were dwarfed, with shorter internodes and slower growth than the original cultivar. Their stems were thicker, and their leaves were larger and darker, with denticulate edges.

Plants from the third clone were similar to the cultivar, except for a more branched structure.

When inoculated in the growth chamber with E. amylovora, the dwarfed plants exhibited a dry necrosis of the stem (with few exsudate) immediately behind the front of bacterial colonization; the necrosis stopped before reaching tissues lignified during the previous growth cycle. Healthy shoots developped from axillary buds just below the limit of the necrotic zone.

With cv "Durondeau" controls, handled in the same way, infected areas were covered with abundant bacterial exsudate, the necrosis as well behind the front of bacterial colonization; bacteria extended through vascular tissues only in the lower part of the stem (less than 1 which were eventually killed.

Plants from the two dwarfed clones were four- to tetraploïd (chromosome number 2n=68), while the third clone and the cultivar "Durondeau" were diploïds (2n = ...).

APPLE BREEDING FOR MULTIPLE FIRE BLIGHT RESISTANCE STRATEGY

[illegible] Jean Pierre PAULIN INRA,
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Apple varieties and selections of the apple breeding programme are tested for resistance to fire blight by shoot inoculation in the greenhouse. The results are used to select the most susceptible and to plant orchards with the least plants. Some of progenies confirm the resistance of parents and were released. Some promising hybrids are both scab and fire blight resistant. Cross combinations and strategy are discussed.

BREEDING UPRIGHT GROWING TYPES OF COTONEASTER FOR RESISTANCE TO FIRE BLIGHT, ERWINIA AMYLOVORA (BURR.) WINSLOW ET AL.

FRIEDRICH PEPSIL
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Our breeding progrem was started in 1974. Already in 1985 16 resistent clones of Cotoneaster dammeri var. radicans had been delivered to a group of nurseries. Two of these clones now are tested at the Federal Plant Registration Office to get the protection of new plant varieties. Breeding work is continued with types of the upright growing species C. franchetii, C. watereri and C. salicifolius. Since the beginning of the selections in 1975 the rate of resistant plants increased from 12 per cent in the segregating parent population of C. franchetii to 86, 76, 63 and 66 per cent in the four offsprings of resistent plants which had been selected in 1985 and tested in 1986. With C. salicifolius and C. watereri until now only the second generation of selection could be tested. In the populations of seedlings from resistent plants of both genera only the percentages of less susceptible plants increased at the expense of highly susceptible plants. The results of the estimations show that it might be possible to build up lines of resistent plants in the upright growing species C. franchetii, C. salicifolius and C. watereri, though they are known to be very susceptible ones.

New Pyracantha resistant to scab (*Spilocaea pyracanthae* (Otth) Bubák) and to fire blight (*Erwinia amylovora* (Burr.) Winslow *et al.*)

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J. BELIN
G.I.E. - SAPHYR

Two new Pyracanthas have been released to trade through the SAPHYR Association of French nurserymen.

Pyracantha Cadrou SAPHYR ROUGE ® and Cadange SAPHYR ORANGE ® have respectively red and orange long lasting heavy fructification. They were selected among progenies of the cross P. 'Shawnee' × P. × Mozart after recurrent inoculations with french and american isolates of *Erwinia*.

The breeding program gave rise to a population of highly resistant plants, usable as a source of other new cultivars.

EVALUATION OF CRABAPPLE CULTIVARS AND SELECTIONS FOR RESISTANCE TO FIRE BLIGHT

Bell, W. G. and D. C. Elwing, Agriculture Canada, Harrow, Ontario N0R 1G0 and Horticultural Research Institute of Ontario, Simcoe, Ontario N3Y 4N5.

Crabapples are increasingly in demand for the plantation of single cultivar stands, espaliers, and for augmenting regular plantings in multi-cultivar orchards. To reduce the potential of introducing fire blight infection into orchards, a program was initiated in 1981 to evaluate crabapple cultivars and selections for resistance to this disease. Trees were propagated onto either Malling 9 seedling or M.26 rootstock and grown in environmental chambers (18-24°C) and in the field (18-28°C). Trees were inoculated by puncturing the stem at the base of the petiole of actively growing shoot tips. A range of susceptibility was observed among the many cultivars and selections presented for fire blight evaluation. Some of the more resistant crabapples may be suitable for both the ornamental and the orchardist industry.

FIELD EVALUATION OF STRAINS OF *Erwinia amylovora* ON SOME APPLE SPECIES AND CULTIVARS. IN THE GREENHOUSE. Jean Pierre BALLIN & Yves LESPINASSE. INRA 49000 Angers France

Four strains of *Erwinia amylovora* (CFBP 1430, CFBP 2045, CUCPE 266, [illegible]) were inoculated by puncture in their shoot tips used in the greenhouse on potted plants. The cultivars tested were: 'Idared' 'Golden' Delicious, 'Golden' Delicious A1, 'Granny Smith', 'Chantecler', 'Quinte', 'Novole', 'Everest', 'Robusta 5', 'Florina' and two scabby resistant selections. The results of incidence and lenght of necrosis are compared. Our choice of strains used in the breeding programmes is explained from these data.

DEGREE OF FIRE BLIGHT RESISTANCE IN PYRUS GERMPLASM COLLECTED IN EASTERN EUROPE. Tor van der Zwet, U.S. Department of Agriculture, ARS, Appalachian Fruit Research Station, Kearneysville, West Virginia, USA.

During 1976-1980, three plant exploration trips were made to five countries of Eastern Europe in search of Pyrus germplasm. A total of 384 accessions (225 from Yugoslavia, 87 from Romania, 43 from Poland, and 10 each from Hungary and Czechoslovakia) were collected as budwood and propagated at the U.S. Plant Introduction Station in Glenn Dale, Maryland. Following 7 years of exposure to the fire blight bacterium (*Erwinia amylovora*), approximately one third of the accessions from each country appeared resistant (0-6% of tree blighted), whereas two thirds blighted severely (50-100% of tree blighted). In addition, 65 of the blight resistant accessions, mainly from Yugoslavia, also have shown a high degree of freedom from leaf spot and insect pests (mainly Psylla), which confirmed original observations. Following virus indexing, this multiple-resistant germplasm is being released from quarantine and incorporated into the USDA pear breeding program in Kearneysville, West Virginia, and will also be maintained at the National Clonal Germplasm Repository in Corvallis, Oregon.

BREEDING PYRACANTHA FOR FIRE BLIGHT RESISTANCE

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In 1975 with Cotoneaster, Crataegus and Pyracantha a breeding programme for fire blight resistance was started and it is still going. To Pyracantha most of the attention in this breeding programme is paid. The programme started with collecting and testing varieties. At this moment the collection consists of 51 varieties. The tests were done in a greenhouse by artificial infection. Crosses between varieties were also made, which resulted in 123 crosses made in previous years. Over 4600 seedlings were tested and a part of them (1410) also was cloned and later on tested again. The crosses showed much variation in percentage plants with symptoms. Within the clones there proved also to be variation in number of attacked plants. Clones which resisted the greenhouse tests were planted in an experimental field with a natural infection pressure for fire blight. Up till now 378 clones of 5 plants were planted. In the field characteristics like leaf susceptibility and winter hardiness also were studied.

[illegible] fire blight [illegible] and susceptible [illegible] infection under [illegible] conditions, the following cultivars and seedlings [illegible] Red Elf, Watereri Berry, were rated in decreasing order of susceptibility to fire blight: Seedling 5-8, Seedling 5-[illegible], Mohave, Seedling 5-7, Seedling 5-1, Beauty Bush, and Bartlett. The rate of bacterial growth on agar media containing equal concentrations of antibiotic extract was inversely correlated with the level of phenolic compounds, especially that of leucoanthocyanidin in the fruit and shoot tip extracts. Elliott was preferred based on its excellent fresh eating quality and longer [illegible] storage.

EFFECTS OF ISOLATE AND ENVIRONMENT SCREENING FOR RESISTANCE TO FIRE BLIGHT. Beer, R.C. and van der Zwet, T., USDA-ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430, U.S.A., Bonn, M. G., Agriculture Canada Research Station, Harrow, Ontario NOR 1G0, Canada, and Thibault, B., INRA, Angers, France.

Eleven genotypes of pear (Pyrus communis L.) and 5 isolates of Erwinia amylovora Burr. (Winslow et al.) were used in various combinations at 3 locations and during two years. Data on hosts and isolates common to all locations and years indicated that in spite of significant year x host x isolate interaction in shoot lesion length, differences among host genotypes were significant, while all other main effects and 2-way and 3-way interactions were non-significant. When the data was converted to percentage of current season's shoot length, location x year x host interaction was significant, and significance of host differences decreased, suggesting that when trials covering several locations are conducted, absolute shoot length is a better measure of disease reaction. Similar results were obtained for frequency of blossom infection, with the exception of significant year effects.

Section E : Control strategies : chemical, biological

Chairman C.H. HALE
Co-chairman J. ZELLER

TIMELY CUTTING OF FIRE BLIGHT INFECTIONS REDUCES LOSSES. R. F. Covey, Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

Even though timely and frequent cutting is typically recommended as a control measure for fire blight of pears there has been little quantitative data to support these recommendations. In 1987 fire blight in a block of 10 to 12-year old Bartletts was cut on three different schedules (treatments). Each treatment was replicated 10 times in a randomized single block design. In treatment I fire blight was cut as soon as it was observed and weekly thereafter; treatment II was cut 2 and 6 weeks later. All treatments including III were cut after the trees were dormant. The plant material removed in the cutting process was cut dried and weighed. The average dry weight of the infected tissues removed was 5.4, 32.7 and 36.2 kg for treatments I, II and III respectively. The number of points of infection in treatment III could not be determined as they had run together; however, there were totals of 206 and 106 in treatments I and II, respectively.

ON THE EFFECT OF PLANT EXTRACTS AGAINST FIREBLIGHT (ERWINIA AMYLOVORA)

Jan-[illegible] Mü[illegible] Fred Bö[illegible] and Wolfgang Ze[illegible]

Federal Biological Research Centre for Agriculture and Forestry [illegible]

Institute for Plant Protection in Fruit Growing, D-6905 Dossenheim

[illegible] studies on the effects of plant extracts against the fruit blight pathogen Erwinia amylovora were carried out under in vitro - and in vivo conditions. In a first screening test 24 plant extracts [illegible] were tested for their inhibitory effect against the pathogen. The most promising of these extracts from Juglans nigra L., Berberis vulgaris L., Thuja occidentalis L. and Rosa rubiginosa L. and Rosa sp. were subsequently compared with Streptomycin (100 ppm). Maximum inhibition of Mycelial growth was found with the Rosa species and a very low minimum germination rate of the bacteria but reduction in size. Under field conditions 3 of the most effective extracts from Berberis vulgaris, Rhus typhina, Malus x floribunda and one from Aesculus hippocastanum showed an appreciable protective action against fire blight on the host plant apple seedlings. Compared to Streptomycin (100 ppm) and copper-oxychloride (0.3 %) used for comparison. From two plant extracts a possible resistance induction effect on the host plant apparently was evident.

BIOLOGICAL CONTROL OF FIRE BLIGHT OF HAWTHORN. Mark Wilson, Harry A. Epton & [illegible] Dept. of Cell and Structural Biology, Stopford Building, University of Manchester, Manchester, M13 9PT, U.K.

Saprophytic bacteria were isolated from the phylloplane of hawthorn trees and tested strains of *E.herticola* and fluorescent pseudomonads. These bacteria were screened for antagonistic activity using an immature pear fruit assay. Antagonistic isolates were then tested for ability to control blossom-blight and shoot-blight of hawthorn. *E herticola* isolates EhWHL9 and EhWHL40; *P.syringae* isolate PsWHL6 and *P.viridiflava* isolate PsWHL53 effectively controlled fire blight in hawthorn. Attempts to reveal the mechanism of blossom-blight control, suggest that site and/or nutrient competition between the pathogen and biological control agent may be of prime importance, but that [illegible] may also play a role. Both the *E herticola* isolates and the pseudomonads produce broad spectrum antibiotics in vitro, but it is not clear whether these compounds are involved in biological control.

FIVE YEARS OF EXPERIENCE IN CHEMICAL CONTROL OF FIRE BLIGHT IN PEAR ORCHARDS IN BELGIUM

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The central problem in chemical control of fire blight not only consists in finding good chemical compounds but also in finding an optimal strategy for their application in orchard. During the last 5 years, we evaluated the following compounds : streptomycine sulfate (100 g a.i./ha), flumequine in different formulations (300 g a.i./ha) and S-0208 (300 g a.i./ha). These three compounds are considered to be equally active.
Different periods of risk are described for pear orchards under natural infection condition : primary blossom, secondary blossom, shoot growing period, fruitlet development. During primary as well as secondary blossom periods, chemical protection of the blossoms is necessary when climatological risk is high. For the prediction of the first fire blight infections during the season in the orchard, the Powell value of 18 degree days above 18.3°C is a useful treshold value. Later in the season, the Billing system with the corrections of the PD values from Schouten can indicate periods with high climatological risk. However, chemical control measures should always be combined with measures to reduce bacterial inoculum in and around the orchard. Systematical prospections of *Crataegus spp.* and other host plants of fire blight in the fruit producing regions by the Plant Protection Service of the Ministry of Agriculture appear to be an important tool for keeping the bacterial inoculum low. In the orchard, all infections should be taken away as soon as possible in order to avoid a wider spread inside and out of the disease in the orchard.

STREPTOMYCIN FOR CHEMICAL CONTROL EVALUATION

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The EPPO expert group on control have agreed guidelines for some standardisation in procedure for evaluating efficacy of candidate [illegible] for fire blight control. The recommended standards are:- 1. chemicals, streptomycin (100 ppm), fire stop (300 ppm), Bordeaux mixture (1 g Cu/l) plus a water only and an *E. amylovora* control. 2. Hosts, Conference pear, Golden Delicious apple, Cotoneaster cambrensis 'Coral Beauty'. 3. Inoculum concentration, 10⁷, 10⁸ or 10⁹ cfu/ml. 4. Minimum material, 200 blossom clusters per treatment. 5. Spray application, at full bloom, the chemicals first and the inoculum within 12 hours. 6. Recording, presence or absence of progressive fire blight in each blossom cluster in about 2 weeks after treatment according to conditions. It is hoped that having common points of reference will facilitate comparisons between different growth conditions and geographical areas.

BIOLOGICAL CONTROL OF FIRE BLIGHT OF PERRY PEAR. Sarah Nicholson, David C Sigee & Harry A S Epton, Dept of Cell & Structural Biology, Stopford Building, Manchester University, Manchester, M13 9PT, U.K.

Surface washings from leaves, bark and flowers of orchard perry pears were plated, and strains of *E.herbicola*, fluorescent pseudomonads and yeasts were selected to test for antagonistic activity against *E.amylovora*. Using the immature pear fruit test, approximately 25% of all *E.herbicola* and fluorescent pseudomonad strains so far tested have shown clear antagonism, while no yeasts have been positive. Preliminary studies involving simultaneous pathogen/'antagonist' inoculation of cut leaves on micropropagated pear plants gave similar results to the pear slice test in the case of pseudomonads but no control was obtained with strains of *E.herbicola*.
Initial field experiments to determine the epiphytic longevity of antagonistic pseudomonads have shown that these can persist on flower surfaces for the duration of the blossom period.

PRELIMINARY EVALUATION OF CHEMICALS EFFICACY AGAINST FIRE BLIGHT

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The protective activity of 27 chemicals for control of fire blight was evaluated during 1986-1988 by the method using pear fruitlets cv. Conference. The experiments were done at 24°C,100% humidity and high infection preasure. The obtained results indicate the best activity of experimental chemical S-0208 (Sumitomo, Japan) at concentration of 0.3%. This preparation almost completely protected fruitlets against infection and development of disease. Agri-mycin 17 (Pfizer,USA) showed also satisfactory efficacy. In general, copper preparations (Miedzian 60, Poland and Champion WP, Agtrol, USA) were quite effective, especially in concentration of 0.5%. However they caused some phytotoxicity effect which was revealed by slight russeting of the fruitlets. The other chemicals (Albarep, Bronopol and experimentals) were uneffective.

CONTROL OF FIRE BLIGHT ON APPLE BLOSSOMS BY *ERWINIA HERBICOLA* EH 252 UNDER FRENCH CLIMATIC CONDITIONS

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The strain *E. herbicola* 252 was shown to be highly effective in reducing fire blight in apple orchard in the Northeastern part of the United States. To determine its effectiveness in reducing fire blight on apple blossoms under french climatic conditions, the strain of *E. herbicola* being tested in Day Labeaut (France). *In vitro*, Eh 252 produces an antibiotic which inhibit *E. amylovora* and seems to be involved in the control of this disease. To substantiate this hypothesis a derivative strain of *E. amylovora* resistant to the antibiotic produced by Eh 252 was isolated and we are comparing the ability of Eh 252 to control apple blossom infections caused by the wild type strain of *E. amylovora* and its antibiotic resistant derivative.

ANTIBIOTICS PRODUCED BY STRAINS OF *ERWINIA HERBICOLA* THAT ARE HIGHLY EFFECTIVE IN SUPPRESSING FIRE BLIGHT

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Strains of *E. herbicola* (Eh) that are highly effective in reducing fire blight infection of pear blossoms produce antibiotics *in vitro*. The different antibiotics produced by Eh318, Eh1087 and Eh252 have been studied. These antibiotics are not inhibitory to *E. amylovora* (Ea) in the presence of certain amino acids; different amino acids inhibit the toxicity of the different antibiotics. The antibiotic of Eh318 has been purified. It has a molecular weight of 2K and appears to be a linear tripeptide composed of alanine and two other non-protein amino acids. In immature pear fruit tests Eh318 and its purified antibiotic both protected pears more effectively from Ea273 than from Ea273R318, a spontaneous mutant of Ea273 that is resistant to the Eh318 antibiotic. These results indicate that the Eh318 antibiotic is produced and is effective *in planta*.

EXPERIMENTATIONS WITH "FIRESTOP" 3M IN THE CHEMICAL CONTROL OF FIRE BLIGHT

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Due to the high variability of fire blight incidence, it is very difficult to assess the efficiency of a chemical under natural conditions of infections. Therefore we used artificial inoculations both in the orchard and the greenhouse to obtain further informations for the optimization of sprays with Firestop against fire blight. Results of several experiments will be presented : effect of spray volume, concentration of chemical, date of application (before and after date of inoculation), length of efficiency period after spray, difference in activity against pear or apple fire blight. From these experiments, it can be concluded that sprays at 3K per ha in 1000 l/ha are very efficient against fire blight on pear, less efficient against fire blight on apple. Sprays must be repeated at intervals to take account of washing by rain. Better results are obtained with sprays applied just before infections and finally the use of a warning system is strongly recommended.

M
J
F
E
C

A
have a much greater
biosynthesis. A crude
which converts N-acetylglutamyl semialdehyde to N-acetylornithine in the arginine biosynthetic
is inhibited by the purified antimicrobial of Erwinia. Kinetic analysis with partially purified
enzyme shows that the antibiotic of Erwinia is a competitive inhibitor of the enzyme with
N-acetylornithine as the varied substrate. The transaminase of Erwinia and Escherichia
a spontaneous mutant of Escherichia that is resistant to the antibiotic of Erwinia are not
inhibited by the purified antibiotic. These results indicate that the antibiotic of Erwinia
altered (resistant) form of the transaminase.

USE OF BACTERIA TOLERANT OF ANTAGONISTIC BACTERIA TO THE STIGMA OF
FIRE BLIGHT OF PEAR TREES. Sherman Thomas
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Erwinia amylovora occurs almost
exclusively on the stigma of the flowers of host plants. The stigma is
the site where the bacterial contact interaction occurs
between E. amylovora and the host. Miller and Burr (1991) Appl.
host
of the organs of the
pistil
stigma

EXPERIMENTS WITH POSETYL ALUMINIUM (Aliette) IN FIRE BLIGHT CONTROL

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Orchard trials using streptomycin were made in 1985 and 1987 on 12- to 13-yr-old Idared/M7 apple trees. Test chemicals were first applied at 75% bloom (1986) or 25% bloom (1987). 24 hr later blossoms were inoculated by spraying with an aqueous suspension of 1×10^8 cfu *E. amylovora* ml^{-1}. Another application of the chemicals was made 24 hr after inoculation at the petal fall (1986) or 100% bloom (1987). Six to eight weeks later the percentage of all treated blossom clusters was determined. In both years, the chemicals significantly reduced the proportion of blossom clusters infected when compared with a water check. In 1986 there was no significant difference in disease control obtained with [illegible] mg active ingredient (a.i.) l^{-1} and 375 mg a.i. l^{-1}, and [illegible] was significantly more effective [illegible]. All rates of [illegible] damage and poor fruit set. In 1987 there was no significant difference in disease control between [illegible] mg a.i. l^{-1}, or between [illegible] mg a.i. l^{-1} and [illegible] mg a.i. l^{-1}.

C. [illegible] OF FIRE BLIGHT BY *ERWINIA HERBICOLA* Eh252 MUTANTS. Alain [illegible] Jean-Louis VANNESTE, Lawrence E. SMART, Carol [illegible] Steven V. BEER, Department of Plant Pathology, Cornell University, Ithaca, NY 14853, U.S.A.

Streptomycin is highly effective in reducing fire blight incidence in apple orchards. It produces an antibiotic which is toxic to *E. amylovora*. To determine the role of antibiotic production in the control of fire blight, we compared the ability of non-antibiotic producing mutants of Eh 252 to reduce fire blight incidence. Mutants of Eh 252 were isolated using a derivative of the bacteriophage Lambda. Two non-antibiotic producing mutants presence of a single Tn*5* insertion has been shown by Southern hybridization using as probe the Tn*5* containing plasmid pHC79. The [illegible] on immature pear fruits revealed that these two mutants could not reduce the development of *E. amylovora* as well as the wild-type strain Eh 252. Therefore, the antibiotic production is involved in the control of *E. amylovora*. [illegible] a library of the wild-type strain is in progress.

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LEBANON

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IRELAND

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By D. Cardon Brown and Boarman

FIRE BLIGHT

IS THE GREATEST DANGER TO THE FRUIT INDUSTRY

Blight is a PREVENTABLE Disease

Fire Blight commonly called "Fire Blight" is caused by microscopic invisible plants that [illegible] growing inside the bark of the tree. No chemical has yet been found which will kill these bacteria without killing the tree.

Blight is the "GREAT WHITE PLAGUE" of the Fruit Industry

[illegible]

FIGHT THE ENEMY—BLIGHT AT [illegible] COSTS

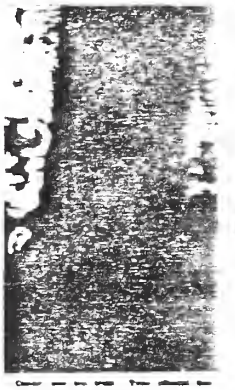
THE DISEASE CAN BE CONTROLLED

Inspection is Necessary

Give the Inspectors Your Support

[illegible] Agriculture State [illegible] Experiment Station [illegible] methods

Write Extension Service to Believe [illegible] or Fly



Cleaning Up "HOLD-OVER" BLIGHT is the Best Means of Prevention

THE ONLY KNOWN WAY TO CONTROL BLIGHT IS BY SURGERY

In cutting it out, cut 6 to 24 inches below the canker. DISINFECT TOOLS AND CUTS WITH CORROSIVE SUBLIMATE.

Ants, flies, ants and other insects are important carriers of blight. Combat them. Birds are [illegible] enemies of insects. Encourage the birds.

Inspect Nursery Stock carefully for blight. Avoid excessive watering of trees.

THERE IS NO PATENT CURE

BEWARE OF THE FAKIR WITH THE "BLIGHT CURES." Do not attempt to cure blight by sprays, tree paints, inoculations or soil "doctoring."

Blight [illegible] Operation and [illegible] Winter is the best time to fight [illegible] NOW is the accepted time. Encourage your neighbors to clean up their orchards.

Eternal Vigilance is the Price of Clean Orchards

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Zwet, T. van der, U.S. Department of Agriculture, Appalachian Fruit Research Station, 45 Wiltshire Road, Kearneysville, WV 25430. (304-728-2329; FAX 728-2340) (1) USA

Working Group Membership by Country [1/]

Algeria	*Anki, N.	
Argentina	Bergna, D. A.	Sampson, P.J.
	*Meyer, F.C.	
Australia	*Cartwright, D. N.	Ikin, R.
	Fahy, D. C.	Wimalajeewa, S.
Austria	*Keck, M.	
Belgium	*Deckers, T.	Porreye, W.
	De Ley, J.	Timmermans, Y.
	Geenen, J.	Vereecke, M.
	Laere O. van	Viseur, J.
	Maroquin, C.	
Bulgaria	*Penev, R.	
Canada	AGR. CAN. LIBRARY	Hunter, C.L.
	*Bonn, W.G.	Lethal, J.
	*Braun, P.C.	McPhee, R.
	Cline, R.A.	Muir, J.
	Coulombe, L.J.	*Rousselle, G.L.
	Davidson, J.C.M.	*Sawatzky, R.
	*Evans, T.F.	*Sholberg, P.
	Howard, F.L.	Yorston, Y.M.
Chile	del Solar, C.E.	
	*Vio, F. R.	
China (P.R.)	Cao, F.	
	*Zhang, Z.	
Cyprus	*Dimova-Aziz, M.	
	Pashiardis, S.	
Czechoslovakia	*Kudela, V.	
	Vondracek, J.	
Denmark	*Dinesen, G.	Mosegaard, J.
	Mikkelsen E.	
East Germany (DDR)	*Kleinhempel, H.	
	Vogelsanger, D.	

[1/] Names with asterisk (*) are contact persons.

Egypt	*Abo-El-Dahab, M. I.	El-Zayat, M.M.
	El-Kazzaz, M. I.	Stino, G.R.
England (U. K.)	Alston, F. H.	Hignett, R.C.
	Billing, E.	Jones, D.R.
	Blakeman, J. P.	Mansfield, J.W.
	Byrde, R.J.W.	Milner, J.S.
	Cooper, R.M.	Roberts, I.
	Ebbels, D.L.	Rowson, G.R.
	Epton, H.A.S.	Sigee, A.C.
	Evans, E.G.	Smith, A.R.W.
	Fox, R.T.V.	Stead, D.
	*Garrett, C.M.E.	Taylor, D.
France	Balavoine, P.	Michon, P.
	Cadic, A.	*Paulin, J.P.
	Chevalier [illegible]	Smith, I.
	Larue, P.	Thibault, B.
	Lecomte, P.	
Greece	Manganaris, A.	*Psallidas, P.G.
	Panagopoulos, C. G.	Tsiantos, J.
Hungary	Klement, Z.	
	*Simon, E.	
India	Gupta, V. K.	
	Sharma, V. P.	
Ireland	*Walsh, P.	
Israel	*Shabi, L.	
Italy	*Bazzi, C.	Mazzucchi, E.
	Calzolari, A.	Oberhofer, H.
	Ercolani, G.	
	Fideghelli, C.	
Japan	*Fujita, K.	Inoue, S.
	Nishio, T.	
Lebanon	*Saad, A.T.	
Mexico	*Fucikovsky, L.	Nuncio, O.
	Mendoza, H.A.	Palacios, C.J.
Morocco	*Chouibani, M.	
Netherlands	Botden, R.J.J.	PUDOC
	Bouma, S.	Scheer, H.A.T. van der
	Heybroek, H.M.	Schouten, H.J.
	Janse, J.D.	*Teylingen, M. van
	Meijneke, C.A.M.	Vuurde, J.W.L. van

New Zealand	Drewitt, W. *Ross, C.M.	
Norway	Dale, T. *Sletten, A.	
Poland	Burkowicz, A. *Sobiczewski, F.	
Portugal	Lopes Barardo, R. *Martins, J.M.S.	
Romania	Richiteanu, A. Severin, V.	*Suta, V.
Russia (USSR)	*Voronkova, L.	
South Africa	*Hattingh, M.J.	
Spain	Carrera, M. Lopez Gonzales, M. Mansergas, A.J.F.	Noval, C. *Palazon, I.
Sweden	*Carlstorp, M. Broeker, G.	Persson, P.
Switzerland	Bolay, A. Cazelles, C.	*Grimm, R. Joseph, E.
Taiwan	*Linn, C.F.	
Turkey	Bayrak, I. Momol, T.	*Oktem, Y.E.
West Germany (BRD)	Dalchow, J. Geider, K. Gessner, E. Graf, H. Knosel, D. Krebs, E.K. Lehmann-Danzinger, H. Lux-Wellenhof, E.	Mappes, D. Massfeller, D. Meyer, J. Michel, H.G. Rudolph, K. Schulz, F.A. *Zeller, W.
Yugoslavia	Arsenijevic, M. Markovic, S. Ognjanov, V.	*Panic, M. Raukovic, M. Ristevski, B.

UNITED STATES

Aldwinckle, H.S.
*Beer, S.V.
Bell, R.L.
Beutel J.A.
*Biggs, A.R.
Bushong, J.W.
Civerolo, E.L.
Cummins, J.N.
*Douglas, S.M.
Egolf, D.R.
*Ellis, M.A.
*Goodman, R.N.
*Hickey, K.D.
Hummer, K.
Janick, J.
*Jones, A.L.
Joshi, M.M.
Kado, C.I.
Koenigsho[illegible], F
Lamb, R.C.
Lindo[illegible] S
Lombard[illegible] P.
Luby, J.
McLaughlin, R
Mielke, G.
*Miller, R.W.
Morton, H.V.
Norelli, J.L.
O'Connor, P.A.
Opgenorth, D.
*Pecknold, P.C.
*Preiser, F.
*Pscheidt, J.W.
Rackman, R.L.
*Ries, S.M.
*Ritchie, D.F.
Roberson, J.
Rom, R.C.
Rosenberger, D.A.
Sands, D.C.
Schafer, T.W.
Schroth, M.N.
Seem, R.C.
Singh, B.P.
*Slack, D.
*Smith, T.J.
Spotts, B.P.
*Steiner, P.
Sugar, D.
Sumida, T.
Sutton, T.B.
Swanson, B.T.
*Thomson, S.V.
Travis, J.A.
USDA Library
VanBuskirk, P.D.
*Wade, E.K.
Willett, M.
Wodzinski, R.S.
*Yoder, K.S.
*Young, D.
Zehr, E.I.
*Zoller, B.G.
Zwet, T. van der

SUMMARY

Contact Persons for Fire Blight Newsletter

United States

Arizona	Young, D.
Arkansas	Slack, D.
California	Zoller, B.G.
Connecticut	Douglas, S. M.
Illinois	Ries, S.M.
Indiana	Pecknold, P.
Maryland	Steiner, P.
Michigan	Jones, A.L.
Missouri	Goodman, R.N.
New Jersey	Preiser, F.
New York	Beer, S.V.
North Carolina	Ritchie, D.F.
Ohio	Ellis, M.A.
Oregon	Pscheidt, J.W.
Pennsylvania	Hickey, K.D.
South Carolina	Miller, R.W.
Utah	Thomson, S.V.
Virginia	Yoder, K.S.
Washington	Smith, T.J.
West Virginia	Biggs, A.R.
Wisconsin	Wade, E.K.

Canada

Alberta	Evans, I.R.
British Columbia	Sholberg, P.
New Brunswick	Rousselle, G.L.
Nova Scotia	Braun, P.J.
Ontario	Bonn, W.G.
Saskatchewan	Sawatzky, R.

Taiwan	Lin, C.P.
Turkey	Oktem, Y.E.
Yugoslavia	Panic, M.

Other Countries

Algeria	Anki, N.
Argentina	Meyer, F.C.
Australia	Cartwright, D.N.
Austria	Keck, M.
Belgium	Deckers, T.
Bulgaria	Penev, R.
Chili	Vidal, R.
China (P.R.)	Zhang, Z.
Cyprus	Dimova-Aziz, M.
Czechoslovakia	Kudela, V.
Denmark	Dinesen, A.
Egypt	Abo-El-Dahab, M.K.
England	Garrett, C.M.E..
France	Paulin, J.P.
Germany (East)	Kleinhempel, H.
Germany (West)	Zeller, W.
Greece	Psallidas, P.G.
Hungary	Simon, E.
Ireland	Walsh, P.
Israel	Shabi, E.
Italy	Bazzi, C.
Japan	Fujita, K.
Lebanon	Saad, A.T.
Mexico	Fucikovsky, L.
Morocco	Chouibani, M.
Netherlands	van Teylingen, M.
New Zealand	Hale, C.N.
Norway	Sletten, A.
Poland	Sobiczewski, P.
Portugal	Martins, J.M.S.
Romania	Suta, V.
Russia	Voronkova, L.
South Africa	Hattingh, M.J.
Spain	Palazon, I.
Sweden	Karltorp, M.
Switzerland	Grimm, R.

SUMMARY

Persons Interested in Fire Blight

Country	Interest Category 1	2	3	4	Total	Number of Contact Persons
* USA - United States	30	34			64	21
* CND - Canada	3	13			16	6
* UK - England	13	5		2	20	1
* BRD - West Germany	9	6			15	1
* NL - Netherlands	6	3		1	10	1
* BLG - Belgium	7	2			9	1
* FR - France	4	4		1	9	1
* EGY - Egypt	1	3			4	1
* SWT - Switzerland	1	3			4	1
* MEX - Mexico	2	2			4	1
* GRC - Greece	1	3			4	1
* SWD - Sweden		3			3	1
* DK - Denmark		3			3	1
* TUR - Turkey	2	1			3	1
* NZ - New Zealand	1	1			2	1
* DDR - East Germany	1	1			2	1
* POL - Poland	1	1			2	1
* NOR - Norway		2			2	1
* CYP - Cyprus		2			2	1
* CZE - Czechoslovakia	1	1			2	1
* IRL - Ireland		1			1	1
* ISR - Israel	1				1	1
* LEB - Lebanon		1			1	1
ITA - Italy			6		6	1
YUG - Yugoslavia			6		6	1
SPN - Spain			5		5	1
AUS - Australia			5		5	1
JAP - Japan			3		3	1
ROM - Romania			3		3	1
HUN - Hungary			2		2	1
ARG - Argentina			2		2	1
POR - Portugal			2		2	1
CHI - China			2		2	1
CHL - Chili			2		2	1
SA - South Africa			1		1	1
MOR - Morocco			1		1	1
OST - Austria			1		1	1
RUS - Russia			1		1	1
TAW - Taiwan			1		1	1
BUL - Bulgaria			1		1	1
ALG - Algeria			1		1	1
IND - India			2		2	
TOTAL	84	95	47	4	230	66

* Countries with fire blight.

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Fire Blight Mailing List Questionnaire

The list of names in this Newsletter is an annual attempt to establish a complete and updated mailing list of all persons interested in fire blight. Please make corrections and additions where necessary and send me any new names not listed. A new list will be prepared for the next newsletter.

☐ My name, address and telephone are correct (if not, show change below)

☐ My interest in fire blight is correct (if not, please indicate below)

☐ My name should be dropped from this list

☐ My/other name should be added to this list

NAME _____

ADDRESS _____

_____

_____ ZIP

TELEPHONE _____

Interest in fire blight research: 1 2 3 4
(see first page of list of persons)

Interest in fire blight newsletter: YES NO

I will serve as contact person for newsletter questionnaire: YES NO

} Please circle one of each

_____

Please return to your contact person or directly to:

T. van der Zwet
Appalachian Fruit Research Station
Route 2, Box 45.
Kearneysville, West Virginia 25430